SCIENCE ADVISORY BOARD
A Federal Advisory Committee to the U.S. Environmental Protection Agency

November 13, 2024

EPA-SAB-25-002

The Honorable Michael Regan
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Transmittal of the Science Advisory Board Report titled, "Review of EPA's draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (draft EJTG)"

Dear Administrator Regan,

The U.S. Environmental Protection Agency (EPA), National Center for Environmental Economics (NCEE) is revising the 2016 EJTG and requested that the Science Advisory Board (SAB) review and provide comments regarding the scientific soundness of the conclusion presented in the draft EJTG. The enclosed report titled, *Review of EPA's draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (hereafter referred to as the "draft EJTG"),* conveys the consensus advice of the SAB. The SAB also undertook a self-initiated advisory activity to provide recommendations on advancing environmental justice science in rulemaking which will be transmitted separately.

In response to the EPA's request, the SAB identified subject matter experts to establish the SAB Environmental Justice Science & Analysis Review Panel (EJSARP) to review whether the methodology described in the EPA's draft guidance is clearly presented and scientifically supported. The SAB EJSARP met virtually on March 24, 2024, to hear a presentation by EPA staff, and in person on April 3-5, 2024, to deliberate on the Agency's charge questions. Follow-up virtual meetings were held on July 25, 2024, and July 30, 2024, to discuss the Panel's draft report. The SAB conducted a quality review of the report during its public meeting on October 15-16, 2024. Oral and written public comments were considered throughout the advisory process. This report conveys the consensus advice of the SAB.

In general, the SAB agreed with many of the conclusions presented in the draft EJTG. The SAB identified many areas that would benefit from further clarification to enhance transparency and increase the utility of the draft EJTG. While the SAB provided numerous recommendations, we would like to highlight the following ones, with additional details presented within the full report. The SAB recommends that EPA consider the following points as they revise its draft EJTG. The first five bullets represent strategies that should be applied in the short-term and the last three bullets will require more sustained efforts to achieve significant, lasting effects:

- A clear framework or step-by-step process for conducting a structured EJ analysis is needed and would promote high-quality, scientifically valid assessments that reliably support health-based regulations. If a choice deviates from what is considered best practice (e.g., if a choice on aggregation level for a factor is based on currently available spatial or demographic resolution and no lower level of disaggregation is available), then it should be stated.
- Terms such as "intrinsic," "extrinsic," "chemical and non-chemical factors," "overburdened communities," as well as the use of "effects" *versus* "impacts" and "cumulative impacts" *versus* "cumulative risks" should be clarified.
- Further guidance should be provided on how to select and examine populations of concern and to identify baseline EJ concerns.
- Further guidance should be provided on the use of qualitative data and mixed-method strategies for integrating qualitative and quantitative data.
- Data quality metrics beyond accuracy, such as precision and error, and uncertainty in data, estimates, predictions, and statistical methods should be considered and documented in all EJ analyses.
- Meaningful engagement, an essential step in addressing EJ concerns, should be strengthened through building relationships by working directly and more closely with affected communities and providing them with more technical assistance, tools, and other resources.
- Leveraging co-regulators, specifically state and local staff to improve and foster additional outreach and engagement activities would be a reasonable conduit to build collaborations and partnerships with EJ communities.
- Retrospective analyses should be conducted to evaluate whether or not implementation of the EJ assessment for an EPA rule or action has garnered expected results and improved the situation for populations of concern.

As the EPA finalizes the draft EJTG, the SAB encourages the EPA to address the SAB's concerns raised in the enclosed report and consider its advice and recommendations. The SAB appreciates this opportunity to review EPA's draft EJTG and looks forward to EPA's response to these recommendations.

Sincerely,

/s/ /s/

Kimberley Jones, Ph.D.	C. Marjorie Aelion, Ph.D.
Chair	Chair
EPA SAB EJSARP	EPA Science Advisory Board

Enclosure

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U.S. Environmental Protection Agency
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ACRONYMS AND ABBREVIATIONS

AQCR	Air Quality Control Region
AQMS	Air Quality Monitoring System
ACS	American Community Survey
CTPP	Census Transportation Planning Products
CAA	Clean Air Act
CBPR	Community-Based Participatory Research
CPI	Consumer Price Index
CPI-U	Consumer Price Index-for Urban Consumers
CSO	Combined Sewer Overflows
DAD	Decide, Announce, Defend
ECOS	Environmental Council of the States
EJ	Environmental Justice
EJTG	Technical Guidance for Assessing Environmental Justice in Regulatory Analysis
E.O.	Executive Order
EPA	Environmental Protection Agency
GAO	Government Accountability Office
HAP	Hazardous Air Pollutant
HIA	Health Impact Assessments
HHRA	Human Health Risk Assessment
HOLC	Home Owners' Loan Corporation
IK	Indigenous Knowledge
KGML	Knowledge-Guided Machine Learning
ICEDM	International Conference on Environmental Data Management
ITRC	Interstate Technology and Regulatory Council
LEHD	Longitudinal Employer-Household Dynamics
ML	Machine Learning
MOE	Margin of Error
Mb-SNA	Model-building Small-N Analysis
Mt-SNA	Model-testing Small-N analysis
MAUP	Modifiable Areal Unit Problem
NASEM	National Academies of Sciences, Engineering and Medicine
NATT	National Air Toxics Trends Station
NEJAC	National Environmental Justice Advisory Council
NCEE	National Center for Environmental Economics
NESHAP	National Emission Standards for Hazardous Air Pollutant
NRC	National Research Council
NSGIC	National States Geographic Information Council
OIG	Office of Inspector General
RIA	Regulatory Impact Assessments
SAB	Science Advisory Board
TEK	Traditional Ecological Knowledge
WHEJAC	White House Environmental Justice Advisory Council

INTRODUCTION

The EPA is revising the *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* (hereafter referred to as the "draft EJTG"), which was originally released in 2016. The draft EJTG is intended to provide Agency analysts with broad guidance on how to assess disproportionate and adverse human health and environmental impacts of proposed rules and actions on vulnerable and overburdened populations as directed in Executive Orders (E.O.) 12898 and 14096 in a variety of regulatory contexts. The EPA states that the purpose of the draft EJTG is to outline analytic expectations and technical approaches and methods that can be used by Agency analysts (including economists, risk assessors, and others) to evaluate environmental justice (EJ) concerns for regulatory actions. Furthermore, EPA notes that senior managers may also find the draft EJTG useful for understanding what role analysis can play in ensuring that EJ concerns are appropriately considered and addressed in the development of regulatory actions. The draft EJTG explains that it is particularly important to integrate EJ into the rulemaking process at its earliest stages to ensure that EJ concerns are given due consideration. Furthermore, it continues this should include informing how to avoid, minimize, or mitigate disproportionate and adverse human health and environmental effects through regulatory design as well as the proposed options, information provision, opportunities for retrospective analysis, the leveraging of statutory authorities, and monitoring, compliance, and enforcement, among others.

The EPA's National Center for Environmental Economics requested that the SAB conduct a scientific peer review of EPA's draft EJTG. In response to the EPA's request, the SAB identified subject matter experts to augment the expertise of current SAB members and established the SAB Environmental Justice Science and Analysis Review Panel (EJSARP) to review whether the methodologies described in the EPA's draft guidance are clearly presented and scientifically supported. The SAB EJSARP also undertook a self-initiated advisory activity to provide recommendations on advancing environmental justice science in rulemaking which will be provided in a separate report.

The SAB EJSARP met virtually on March 24, 2024, to hear a presentation by EPA staff, and then at an in-person meeting on April 3-5, 2024, to deliberate on the Agency's charge questions. Another virtual meeting was held on two non-consecutive dates, July 25, 2024, and July 30, 2024, to discuss the EJSARP's draft report. The SAB conducted a quality review of the draft report during its public meeting on October 15-16, 2024. Oral and written public comments were considered throughout the advisory process.

The SAB has identified numerous instances in which the methods and procedures in EPA's draft EJTG could be revised to be more thorough and transparent. This report is organized by the charge questions raised by the Agency and followed by the SAB consensus recommendations. Tier 1 recommendations are deemed as important for improving the transparency of the Agency's conclusions and to bolster the supporting evidence for them. Tier 2 recommendations are included for the EPA to consider as the Agency revises its assessment, and Tier 3 recommendations represent suggestions to inform future reviews or research efforts. In the panel's report, all recommendations were found to be either Tier 1 or Tier 2. The recommendations are followed by a more detailed response describing the revisions necessary to improve the critical scientific concepts, issues, and/or narrative within the EPA's draft EJTG. A list of acronyms and abbreviations can be found at the front of this report to assist in orienting the reader to the terminology used throughout the Panel's responses to the Charge Questions. Additional editorial comments are presented in Appendix A and a brief discussion of structural racism is presented in Appendix B. All materials and comments related to this report are available at: https://sab.epa.gov/ords/sab/r/sab_apex/sab/advisoryactivitydetail?p18_id=2642&clear=18&session=15905589203730 .

RESPONSE TO CHARGE QUESTIONS

Charge Question #1 – Clarity and Technical Accuracy

Please provide your overall impressions of the clarity and technical accuracy of the EJ Technical Guidance for analyzing the impacts if EPA regulatory actions on communities with environmental justice concerns of EPA regulatory actions. Are there topics that warrant more discussion? Are there any inconsistencies or inaccuracies in the way an issue or topic is discussed within or across chapters?

To improve the clarity and technical accuracy of the draft EJTG, the Panel offers the following recommendations.

Recommendations:

Tier 1:

- The SAB recommends more specificity for analysts to determine the type of environmental justice (EJ) analysis to conduct for a particular rule or issue, including a list of recommended tools and the associated results that would be useful in regulatory applications.
- The SAB recommends that EJ assessments in rulemaking consider other sensitive or vulnerable groups more explicitly (e.g., children, elderly), under the definition of population groups of concern; also, because "Tribal Affiliation" is a relatively new EJ category established in E.O. 14096, this topic requires more discussion and elaboration.
- The SAB recommends a more comprehensive section on characterizing uncertainty and variability in exposure and risk assessments, particularly when such assessments are crude or rely on proximity-based approaches.

Tier 2

- The SAB recommends additional discussion on the best ways to combine quantitative and qualitative data and utilize mixed-methods strategies for EJ analysis.

- The SAB recommends retrospective analyses be conducted to evaluate whether or not implementation of the EJ assessment for an EPA rule or action has garnered expected results and improved the situation for the population groups of concern.

According to the EPA, the draft EJTG is intended primarily for EPA staff conducting EJ analyses to support EPA regulatory actions and rulemaking. Overall, the Panel finds the draft EJTG to be well-written, structurally sound, and logically organized. Chapter 1 introduces the EOs that established the need to consider EJ in regulatory analysis and rulemaking and outlines the main objectives of the draft EJTG. Chapter 2 provides background information and key definitions needed to follow the discussions in subsequent chapters, and the remaining chapters examine in more detail the key analytical considerations, contributors to EJ concerns, data limitations, methodological gaps, and technical issues that should be considered when conducting an EJ analysis.

The SAB understands the challenges and difficulties associated with providing a consistent set of guidelines for conducting EJ analyses for regulatory actions that are conceptually valid, scientifically rigorous, empirically sound, and reflect the latest developments in geospatial data, tools, and methodologies. The SAB commends the authors for the impressive level of detail included in the draft EJTG and finds that the analytical considerations and recommendations presented are generally well justified. The definitions provided are easy to follow, complex concepts are clarified, and the strengths and weaknesses of current approaches for EJ analysis are described in adequate detail. Both Appendix A and B of the draft EJTG are useful and complement the information included in various chapters. The draft EJTG is also generally responsive to the main recommendations provided by the SAB during its review of the previous 2016 version of the EJTG. While the SAB did not find serious technical errors, major inconsistencies, or glaring omissions, there are several topics that warrant more discussion in the draft EJTG. These limitations and related recommendations are described below.

Providing Clear Guidance to Analysts

The draft EJTG provides many different recommendations for conducting an EJ analysis across the various chapters. Since these are dispersed through multiple chapters, the SAB suggests that a brief but comprehensive summary (one or two pages) containing bullet points that list the high-priority recommendations that are discussed in the individual chapters be included. This will be beneficial to both the analyst conducting the EJ analysis, as well as members of the public interested in examining the EJ analysis conducted by the analyst. The draft EJTG should clearly identify who are considered Agency analysts; for example, this may include not only supply side/neoclassical economists, but also ecological economists.

Despite the inclusion of multiple EJ concerns, the overall focus of the draft EJTG appears to be mainly on distributive EJ analysis looking at environmental benefits and harms across communities, and the fairness or equity of that distribution. More information should be provided on a scientifically valid framework and/or guidelines for participatory or procedural EJ. Although aspects of the EPA's EJ definition that emphasize "meaningful involvement of all people" and "equal access to the decision-making process" are mentioned in the draft EJTG, more clarity and information should be provided on how meaningful involvement/engagement or equitable access can be achieved, what barriers currently exist that could impact meaningful engagement for a proposed regulation, what specific criteria or steps should be used, and what metrics can be used to evaluate success when implementing procedural EJ strategies. For example, Chapter 3 of the recently published National Academies report on *Constructing Valid Geospatial Tools for Environmental Justice* (NASEM, 2024) provides a workflow (Table 3.1) and guiding principles (Box 3.2) for conducting meaningful community engagement and presents a conceptual framework for incorporating community engagement (Figure 3.2) that could be utilized by the EPA for EJ analysis in regulatory actions.

Due to the heterogeneity among environmental regulations, as well as the large variety of environmental issues considered, the SAB is concerned that the draft EJTG did not provide the needed specificity for analysts to determine the type of EJ analysis to conduct for a particular rule or issue. Specifically, the SAB observes that the draft EJTG could be more user-friendly for analysts seeking to conduct an EJ analysis for a particular regulation, whether for specific media (e.g., air, water, or soil) or for specific states. The SAB therefore recommends the inclusion of specific examples and illustrations demonstrating how EJ analyses have been conducted for different EPA regulations in multiple contexts and settings when addressing different EJ issues. An example of a state air regulation that could provide feasible, specific, concrete, actionable advice is California's Assembly Bill 617[1] for Community Air Protection. Additionally, it would be beneficial to provide a list of recommended tools and their products that would be useful in regulatory applications.

Inclusion of Affected Communities and Use of Appropriate Data

The SAB notes that because "Tribal Affiliation" is a relatively new EJ category established in E.O. 14096[2], this topic requires more discussion and elaboration. The SAB also notes that the Bureau of Indian Affairs that works more closely with Tribal and Indigenous communities has better and more reliable survey data on these communities, compared to the American Community Survey (ACS). It is important to consider that Indigenous Knowledge (IK), while mentioned throughout the draft EJTG, is noticeably missing from Section 6.3, titled, Data and Information to Assess EJ Concerns. There appears to be a conscious effort to include IK throughout the draft EJTG, except in this section regarding data. If access to IK is granted, it can be a vital component of an EJ analysis and exploration of EJ concerns and should be included in Chapter 6. Regarding potential gaps between "regulatory data" and IK, a recent article by Hill *et al.,* (2020) that presents a review of an international framework for incorporating IK into "western science" may be helpful.

Limitations Associated with EPA's Proposed Analytical Methods

EPA's proposal that analytical evaluations be related to baseline, regulatory options, and whether impacts are exacerbated or mitigated in the introduction needs further explanation as to how the outcomes generated will inform the regulatory decision. Further explanation and guidance also are needed on how the outcomes generated will be evaluated in a retrospective analysis to determine whether or not regulatory decisions have improved conditions for the population groups of concern.

Additionally, there needs to be a more comprehensive section on characterizing uncertainty and variability in exposure and risk assessments, particularly when such assessments are inconsistent with lived-experiences or rely on proximity-based approaches. Analytical issues resulting from spatial clustering or dependence on geospatial datasets (e.g., spatial

[1] See https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB617
[2] See https://www.federalregister.gov/documents/2023/04/26/2023-08955/revitalizing-our-nations-commitment-to-environmental-justice-for-all

autocorrelation problem) used for EJ analysis warrant more discussion. Statistical methods that consider or correct for such spatial effects in modeling relationships between environmental and socio-demographic variables (Chakraborty, 2011; Mennis and Heckert, 2018) should be described and emphasized.

The SAB also notes that the issue of statistical significance needs to be addressed. Several example assessments provided by EPA for specific regulations do not clarify if differences among various socio-demographic groups examined are statistically significant (i.e., significantly different from zero).

Although the need to incorporate qualitative data is mentioned, the best way to combine quantitative and qualitative data for EJ analysis warrants more discussion. For example, Lieberman (2005) provides a workflow (Figure 1, p. 437) and examples of "Model-testing Small-N analysis" (Mt-SNA) nested or "Model-building Small-N Analysis" (Mb-SNA). Also see Seawright and Gerring, (2008) and Seawright, (2016) for additional information on qualitative and quantitative options and tools. The SAB understands the reliance on data quality as the backbone for defining EJ and technical approaches, but it is important to acknowledge that data quality is predicated on data quantity, availability, reliability, and national consistency. The draft EJTG should emphasize the necessity of having a presence in the field to experience EJ through the eyes of local residents living in conditions with cumulative exposures or impacts, rather than discrete and disparate EJ stressors.

<u>Other Considerations</u>

Section 6.7.1 of the draft EJTG discusses the uneven cost burden that may result from some regulations. However, it may also be important to consider any economic advantages or financial benefits that may be associated with the regulation for specific groups. For example, a reduction in long-term energy costs could occur from policies that promote renewable energy deployment.

An additional inconsistency throughout the draft EJTG that should be addressed is the use of citations and references either within the text, as a footnote, in the References section, or contained in the Table of Appendix A titled 'Select EPA Guidance Documents'. The SAB recognizes that developing guidance documents is a time-consuming process, and many of the documents referenced are likely to be in various states of draft or revision. Nevertheless, the citations of EPA guidance documents should be presented in a consistent manner. The SAB suggests that a complete list of EPA guidance documents that are referenced in the draft EJTG and potentially used by EPA analysts be included in Appendix A.

The SAB was also concerned that the draft EJTG does not provide any explicit acknowledgement of the state's role as co-regulator with EPA in regulations that will be implemented as a result of the rulemaking process. Practicing meaningful involvement with EPA's co-regulators early and often, and not just as a footnote, can enhance protection of public health and the environment as well as prevent potential future litigation by states over proposed rules. Including federal, state, and local-level regulatory staff in EJ regulatory decision-making can build trust and develop methodologies with transparency that is much needed.

Additionally, the SAB recognizes that it is difficult to conduct a nationally consistent and scientific "EJ Analysis" for rulemaking when EJ itself is not consistently defined nor implemented nationwide, nor is it written into federal law. Place-based considerations as well as IK may not be implementable nationwide. Only 13 states have EJ explicitly institutionalized as law, and 14 states' environmental regulatory agencies include EJ policies.

Charge Question #2 – Key Definitions

Chapter 2 discusses key definitions and the way in which meaningful involvement might inform analysis. Does this discussion provide sufficient background to analysts? Are there additional definitions that should be included?

The SAB notes several instances where key definitions are missing or require further clarity. The discussion of meaningful engagement is incomplete and greater detail is needed. The SAB provides the following recommendations regarding ways to revise and improve the EJTG.

Recommendations:

Tier 1

- The SAB recommends that EPA clarify specific definitions and explain how these terms are being applied including "structural and systemic barriers," "equity," and "overburdened communities."
- The SAB recommends the use of interactive maps, data dashboards, and other approaches (e.g., story maps) for data visualization with subtitles and translation(s) into the language(s) spoken in the applicable community/region (e.g., language access is connected to environmental justice) where engagement activities are being conducted.

Tier 2

- The SAB recommends including a discussion on Tribal treaty rights and the constitutional obligations to not violate those rights.

EPA has previously received comments about its community engagement processes including recommendations that EPA emphasizes the importance of involving communities early when conducting EJ analyses. EPA should reference relevant reports in the draft EJTG from EPA's National Environmental Justice Advisory Council (NEJAC) and other published studies on how to ensure more effective public participation, and the importance of transparency and clarity for the public. EPA can also benefit from committees like NEJAC and the White House Environmental Justice Advisory Council for definitions of the terms used in the draft EJTG to improve consistency and develop a mutual understanding of the issues in this field.

In Chapter 2 of the draft EJTG, the Agency has attempted to be responsive to the feedback about its community engagement processes by:

- Summarizing key elements of meaningful involvement in the regulatory process from other EPA policies and documents as well as other published studies.
- Emphasizing ways in which meaningful involvement may inform and improve EJ analysis.
- Discussing the importance of accessible, plain language to increase transparency.

Clarifying Definitions and Associated Terminology

The SAB notes that there are several areas in Chapter 2 of the draft EJTG that can benefit from further clarification. For example, the following terms warrant acknowledgement, clarification of specific definitions, and explanations on how these terms are being applied: "structural and systemic barriers" and "equity." Additionally, the term "overburdened communities" is a key term whose definition should be included in Chapter 2 with other key definitions. It is currently introduced in Chapter 4, but it should be introduced sooner in the section of key definitions of Chapter 2. Furthermore, guidance on what EPA means when it refers to "disadvantaged communities" is also warranted. Different states may have similar or overlapping definitions. In California, "disadvantaged community" is used in the state regulatory realm[3] and largely means the same as the federal definition of "overburdened community." That is, communities that are overburdened are disadvantaged. Thus, clear definitions of similar terms are needed for shared understanding of EJ analysts at EPA and state agencies across the US. It would be useful to include a box (with non-exhaustive but helpful lists) to illustrate examples of how "overburdened" and "disadvantaged" are operationalized in the context of EJ analyses. If EPA provides more clarity about what it means when using specific terms, it will help increase transparency for all stakeholders.

Cumulative impacts are referenced, but are not well defined in the draft EJTG, particularly with respect to effects. There should be clarification around when it may not be appropriate to include cumulative impacts or risks. Are these two terms interchangeable? Are there specific criteria that can be used to determine when such information should or should not be included? When the term "differential" is used, does that refer to some pattern in the data significantly differing from random noise? Further clarification is needed.

In Section 2.1 of Chapter 2, it would be helpful to distinguish between the terms "difference" and "differential" in terms of statistics. The draft EJTG should clarify whether or not these terms are being used interchangeably. In statistical analysis, differences are usually expressed in terms of the mean, but it may also be important to consider differences in the overall distribution between two or more groups. Although it is unclear what the statistical impact would be (e.g., perhaps quantile regression or something similar), this seems to be an important consideration. Whether or not an analyst finds a statistically significant difference in, for example, an exposure

[3] See California Senate Bill 535: https://legiscan.com/CA/text/SB535/id/179871

between two defined groups is important. If the relevant data set is large, it is easy to find statistically significant differences (e.g., statistical significance is affected both by the size of the true effect and the number of observations that are used to measure the effect). As a result, the confidence that the difference between two groups is not zero is greater, even if the difference is small.

In Section 2.2 of Chapter 2, as noted in the EJTG, the use of the Consumer Price Index (CPI) is problematic and has been known to be so for quite some time now. One example of the challenges when using the CPI for *All Urban Consumers* (CPI-U) was demonstrated during a period when energy costs rose by more than 50% and the prices of some commonly purchased grocery items increased by nearly 30% yet the CPI continued to show a very modest inflation rate[4]. In contrast, other indicators measuring the buying power of consumers showed a dramatic increase in the cost of living. Some other limitations of the CPI include the fact that it has an urban-centric bias.

Additionally, the CPI does not produce official estimates for the rate of inflation experienced by subgroups of the population, such as the elderly or the poor. Factors such as social and environmental changes and changes in income taxes are beyond the definitional scope of the CPI and are excluded. The CPI does not measure qualitative changes or substitution of goods. Furthermore, with reference to population groups of concern, when accounting for unemployment, it is important to use U-6 and not U-3 unemployment. The U-3 unemployment rate is the most commonly reported rate in the United States, representing the number of unemployed people actively seeking a job. The U-6 rate covers discouraged, underemployed, and unemployed workers in the country.

<u>Effective Meaningful Participation/Involvement Practices</u>

Page 12 of the draft EJTG states, “Community engagement works best when affected individuals and communities are consulted early and often.” It is also important to recognize that it takes time for meaningful engagement to be achieved. Meaningful engagement and establishing trust and constructive working relationships with communities is an ongoing job that requires mutual bidirectional efforts, unlike outreach which is a one-way endeavor. The Agency should be willing to invest the time needed to ensure that engagement is authentic and, indeed, meaningful. The SAB also notes that it is difficult to separate how to use the results of meaningful engagement and participation from the process of fostering meaningful and useful engagement. Relevant information on population impacts can be acquired directly from the leaders of the affected community (e.g., church leaders, business leaders, tribal councils) by attending community meetings and allowing open dialogue. Additional sources and methods, such as citizen science/community based participatory research and participatory budgeting are related issues that should also be discussed more prominently as they pertain to meaningful engagement/involvement. Other important stakeholder, the states, are considered a part of the

[4] “Impact of commodity price movements on CPI inflation” https://www.bls.gov/opub/mlr/2012/04/art3full.pdf

public. EPA should indicate where engagement with states is integrated into the rulemaking process.

Environmental communication scholars have frequently criticized traditional public hearings. Some describe rulemaking processes as a form of Decide, Announce, Defend (DAD) participation processes because public voices can be ignored or overlooked. Thus, public hearings or comment periods become "perfunctory" processes to legitimize decisions already made (Hendry 2004; Susskind 1985; and Walesh 1999). In fact, public hearings were first characterized as meaningless involvement in a seminal 1969 publication (Arnstein 1969). Researchers have documented how scholars often see public hearings as insufficiently "open, transparent, or fair" (Hunt, Walker, and Depoe 2019). They also observed how many see existing participatory "laws, processes and institutions" like those associated with the Administrative Procedures Act (APA) and the National Environmental Policy Act (NEPA) as "antiquated" and "no longer adequate to support robust public engagement." Law professor, Jonathan Skinner-Thompson (2022, p. 399) stated the following, "While established administrative policy purports to provide all people with so-called *meaningful involvement* in the regulatory process, the public participation process often excludes marginalized community members from exerting meaningful influence on decision making." He continued: "Especially in the environmental arena, regulatory decisions are often buried among engineering analyses or modeling assumptions." This underscores the importance of hearing and acting on the feedback of communities and those negatively affected by regulatory decisions.

In referencing Arnstein's work, Skinner-Thompson advocated for a participatory process that empowers citizens. After all, "participation without redistribution of power is an empty and frustrating process for the powerless" wrote Arnstein (1969). She added: "It is the redistribution of power that enables the have-not citizens, presently excluded from the political and economic processes, to be deliberately included in the future." In addition, Gauna (1998) argued, only by transforming the neutrality paradigm in Agency managed participatory processes to support nonneutral intervention on behalf of marginalized communities, "can justice claims surface, survive, and thrive." She predicted in her seminal 1998 article that: "environmental justice is in danger of stalling at the stage of aspirational policy statements served to a limited audience or isolated projects lacking substantial integration into all regulatory programs."

By recognizing terms such as "differential," which might be used as a substitute for "disparity" and/or "disproportion," in the context of an "EJ community" lacking "meaningful involvement," progress might be made. In paradigms of differential power, where industries as members of communities have more resources and voice, residential community members lack equity in meaningful involvement to decision-making, such as with permitting. An EJ community is synonymous with historical-marginalization and being under-resourced, where (industrial) facilities commonly have permits to emit chemical pollutants that collectively expose residential community members to chronic, long-term harmful chemicals – these conditions are component contributors to cumulative impacts. This scenario combined with concurrent non-chemical stressors, such as older housing stock, urban noise, lack of greenspace, and other social determinants of health – brings to bear Title VI civil rights injustices (London, 2024; MacIver, 2022; US EPA, 2022).

To address some of these concerns, prior to beginning the rulemaking process, EPA Regional Offices should be cultivating relationships with constituents from communities with EJ concerns so that trust is being developed prior to the initiation of the process, development of projects or implementation of policies. In the rule-making process, achieving geographic diversity is critical when soliciting public comment. Getting feedback from large urban centers will not suffice when the Agency also needs to learn and understand the concerns of residents living in Middle America, rural areas, and other community contexts, particularly those that use subsistence consumption practices.

The limitations associated with public participation processes should be presented in a transparent way to communities and the broader public that can be clearly understood, including the implications of those constraints on the decision-making process. With respect to meaningful involvement, groups most affected by and vulnerable to a project or policy should be targeted and included. The public should not be asked for input unless there is readiness to act upon that input. All requests for input and information using, for example, surveys or other methods, require feedback and transparency about expectations. EPA should fully consider public comment and be clear, when reporting back to stakeholders, about what input was used and what was not used in the context of decision-making.

When concerns are presented by community members and others, in the context of the public comment process, about negative impacts to human health and the environment resulting from a proposed EPA action, the Agency should be willing to change course/change policy/change the permit/suspend the project. Often, the process seems to be more performative. Despite thousands of salient comments, the policies/permits/practices do not change. Meaningful involvement refers to involvement that leads to meaningful results.

In Section 2.3 of Chapter 2 (text box 2.2), the content appears sparse. There is no mention of equity in the process of planning for effective community engagement. The section on meaningful involvement warrants more discussion of the "structural racism" inherent to the traditional process of rulemaking (e.g., notice-comment-hearing) and informal public engagement (see Appendix B of this report for an example of structural racism). In the textbook entitled, *Environmental Politics and Policy,* Rosenbaum, (2023) describes how regulatory rulemaking, permitting, and enforcement activities involve "policymaking beyond public view." Regulatory processes are highly specialized and often limited to "organized interests, governmental officials, technicians, and other insiders" according to Rosenbaum, (2023, p. 146). Chapter 2 can be greatly improved if an excellent example of meaningful involvement, possibly from the regions, is included in the draft EJTG as a case study.

Engaging with Tribal Nations is an issue that warrants additional discussion. As is mentioned in response to Charge Question 1, "Tribal Affiliation" is a new class for EJ protection established in E.O. 14096. This topic warrants more discussion in Section 2.2.1. In addition, Chapter 2 of the draft EJTG currently includes no discussion of treaty rights and the constitutional obligations to not violate those rights. Many treaties have established reserved rights for Tribes to hunt and fish in "usual and accustomed" places throughout their original territory. Some legal scholars and courts interpret those treaties as establishing a "right to nature" for Tribal members. These rights can be impacted by environmental justice concerns. In the recent decision in the "Culvert Case"[5] or *State of Washington v United States,* the court upheld the Suquamish Tribe's claim that leaving culverts in place which block the passage of salmon was a violation of treaty rights by the State of Washington. Many assert that treaty obligations are being violated by failing to do more to restore and protect the healthy environmental habitats supporting wild salmon populations in the Pacific Northwest (Blumm, 2017). Moreover, the state constitutions of Hawai'i, Illinois, Massachusetts, Montana, New York, and Pennsylvania declare a right to a quality environment (Dernbach, 2023).

E.O. 14096 begins with an affirmation that "every person must have clean air to breathe; clean water to drink; safe and healthy foods to eat; and an environment that is healthy, sustainable, climate-resilient, and free from harmful pollution and chemical exposure. Restoring and protecting a healthy environment— wherever people live, play, work, learn, grow, and worship—is a matter of justice and a fundamental duty that the Federal Government must uphold on behalf of all people" (p. 25251). This may extend the "right to nature" (Smith, 2024) to all US residents enshrined in many treaties with American Indian Tribes. Consequently, this consideration is important for the three questions regulatory analysts need to consider as presented on page 15 of the draft EJTG.[6] Adding some language from EPA's 2016 *Guidance for Discussing Tribal Treaty Rights* (EPA 2016), along with a hyperlink to this 2016 document, in Appendix A of the draft EJTG would be helpful.

On page 11 of the draft EJTG, it states "special attention is often needed to ensure meaningful involvement by communities with EJ concerns." This likely has different meanings for overburdened/disadvantaged/historically marginalized communities, or rural communities, compared with Tribal Nations (federally recognized or unrecognized), and this should be acknowledged. Sovereign Nations may have their own perspectives on time and timelines, that could span generations, and may differ from those of other governments and groups.

Some additional references that provide useful background information to advance the understanding of more effective meaningful community engagement include but are not limited to works by Aguilar-Gaxiola *et al.,* (2022); Arnstein, (1969); Dernbach, (2023); and Hendry, (2004).

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[5] See https://www.supremecourt.gov/DocketPDF/17/17-269/36516/20180224122759789_17-269tsBrief.pdf

[6] The analysis of EJ concerns for regulatory actions should address three questions:

• **Baseline**: Are there existing (baseline) EJ concerns associated with environmental stressors affected by the regulatory action for population groups of concern?

• **Regulatory options**: Are there potential EJ concerns associated with environmental stressors that are affected by the regulatory action for population groups of concern for the regulatory option(s) under consideration?

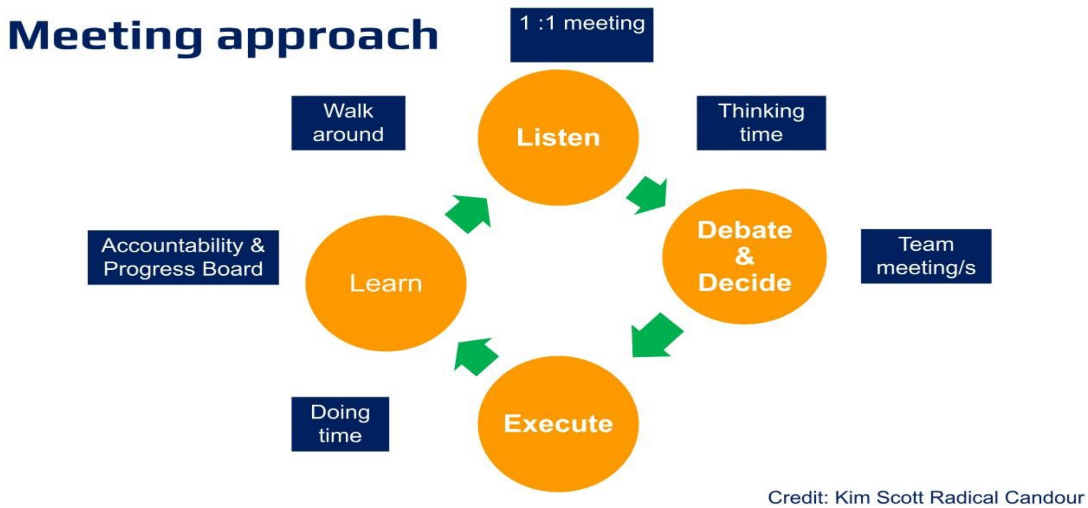
• **Mitigation or exacerbation of impacts**: For the regulatory option(s) under consideration, are EJ concerns exacerbated, mitigated, or unchanged compared to the baseline?

Communication and Outreach to Enhance Community Engagement

The Federal Register is the U.S. government's 'go to' place for advertising public comment periods. Many members of the public who are not regularly involved in EPA processes have never heard of the Federal Register. To increase community engagement in the rule-making process, EPA should first determine how the relevant public will be contacted and kept abreast of the process. How will events be advertised? If social media is used as one approach, EPA should be careful to use the platforms that reach a broad age demographic (e.g., currently Instagram, Facebook, Twitter/X, etc.). In-person tools should also include information kiosks/tables at conferences such as the Appalachian Studies Conference. EPA should also consider: a) sending out a detailed agenda for meetings at least 48 hours prior to the meeting, b) publicizing how often EPA plans to hold such meetings and where the meetings will be held, c) being clear on objectives of stakeholder meetings, d) scheduling meetings when the largest number of stakeholders can attend, and e) highlighting in advance individuals and groups from whom EPA is seeking input, using accessible language based on key stakeholder demographics. If remote meetings are used, it is important to note that there may be internet accessibility issues in rural areas and/or tribal communities as well as in some urban contexts. For meaningful engagement to be better incorporated into EJ analysis, there must be a diverse set of approaches used to share information with the public in general, and in particular, for communities that may be impacted.

EPA should not rely solely on remote meetings for outreach and community engagement, although their ease of access and lower costs relative to in-person meetings are noted. However, there is no substitute for personal interactions with affected communities and in-person visits to "ground truth" EPA's assumptions, models, and data sources. To partially address concerns related to effective in-person meeting with the public as a part of the rulemaking process, EPA might offer formal training in facilitation to individuals participating in community engagement or engage professional facilitators at meetings. Using Kim Scott's Radical Candor (Scott, 2017) method is one approach as shown in the flow diagram below (Figure 1) with applicable modifications whenever and wherever necessary.

Figure 1 – Radical Candor Approach



When communicating with impacted communities and the broader public about new rules, EPA should utilize interactive mapping tools customized for the regulation, facility, or for the specific community interaction. These maps should include any relevant data and allow communities to self-identify and suggest data additions/eliminations.

If information repositories include data, relevant spatially explicit data should be available in multiple formats to allow individuals to download them into platforms such as Google Earth or ArcGIS. Data in information repositories should be both mapped and summarized to help communities better understand the data. For example, the rich data contained within EPA's "Comprehensive Data Collected from the Petroleum Refining Sector" is valuable but inaccessible and hard for the general public to understand. It should be mapped, with the data visualized, and summarized in formats that can appeal to a broad audience. Reliance on charts and graphs is not sufficient. Rather, newer data visualization tools like Tableau, Klipfolio, Domor, or some of the new templates in ArcGIS Online Pro should be explored to help communicate data to the public. In creating visual representations of data, the Agency should use interactive maps, data dashboards, and other approaches for data visualization with subtitles or translated into the most prominent second language in a given community/region (e.g., Spanish, etc.) where engagement activities are being conducted.

Charge Question #3 – Best Practices

Are the five overall recommendations and list of best practices in Chapter 3 reflective of sound scientific principles and the technical literature? Are there any analytic recommendations that should be added or removed?

The SAB concluded that the EJTG currently lacks specificity and should provide a more detailed strategy for conducting a robust environmental justice analysis to inform regulatory actions. The SAB provided recommendations on potential tools and processes to improve the utility of the EJTG for analysts.

Recommendations:

Tier 1

- The SAB recommends the inclusion of clear/structured analytical guidance or a blueprint, illustrated using examples from the technical literature or regulatory investigations, such as California's AB 617 Community Air Protection Program Blueprint 2.0 (California Air Resources Board, 2023[7]), to show what constitutes a well-crafted and meaningful EJ analysis to inform federal rulemaking. Deviation from the blueprint should be justified and documented.
- The SAB recommends providing guidance on determining what types of qualitative data are appropriate.
- The SAB recommends providing guidance on determining appropriate goals at the outset of the analysis and measuring progress or attainment of these goals.
- The SAB recommends providing guidance on identifying and prioritizing population groups, or the population(s) of concern.
- The SAB recommends providing guidance on how to choose the appropriate geographic unit of analysis and how to define baseline.

Tier 2

- The SAB recommends providing guidance on how qualitative data could be used with quantitative information.
  - The SAB recommends that clarity be provided on what is considered acceptable with respect to qualitative data.
  - The SAB recommends that a more robust description of mixed-methods strategies be added for combining quantitative and qualitative data for EJ analysis.

The SAB generally agrees that the recommendations and best practices described in Chapter 3 of the draft EJTG are scientifically sound and appear to have been developed with a good understanding of the pertinent research literature. The SAB has the following responses to the five overarching recommendations presented in the draft EJTG.

The first recommendation instructs analysts to use their professional judgment to decide on the analysis that is feasible and appropriate. The SAB considers this inadequate given the considerable complexity of designing a meaningful EJ analysis appropriate for federal

[7] See https://ww2.arb.ca.gov/resources/documents/final-community-air-protection-blueprint-2-0-2023

rulemaking and recommends that the draft EJTG include a clear/structured analytical guidance or blueprint, illustrated using examples from the technical literature or regulatory investigations to show what constitutes a well-crafted and meaningful EJ analysis to inform federal rulemaking. This structure and the examples should include guidance on how to select and examine population groups of concern for any EJ analysis, appropriate methods for disaggregating data by demographic measures, specific guidance on how "population groups" are defined, and on selecting (or perhaps prioritizing) metrics in terms of their scientific defensibility and to minimize co-correlation. Deviation from best practices should be justified and documented.

There are several variables to consider (e.g., availability of data, regulatory requirements, varying data quality among metrics such as spatial resolution, time relevance, accuracy and precision, attribute relevance, etc.) and the examples used should guide analysts on how to accommodate these types of situations. Clear guidance on the most appropriate data sources should also be included.

The draft EJTG recommends quantitative analysis yet qualifies this by saying "when such data are not available, it may still be possible to evaluate potential risk or exposure using other metrics (e.g., proximity to affected facilities, cancer or asthma prevalence, or evidence of unique consumption patterns by race, ethnicity or income) in a scientifically defensible way." While data on proximity to affected facilities might be relatively easy to acquire, data on cancer/asthma prevalence or unique consumption patterns can be restricted to some users and could be challenging to obtain. This recommendation should emphasize that data on demographic characteristics or categories might be easier to collect and more accessible compared to data on disease prevalence or consumption patterns by race, ethnicity or income.

Where appropriate, particularly in the absence of quantitative information, the draft EJTG should include guidance on the use of qualitative information. Important elements should include the types of qualitative data that are appropriate, how they could be used with any quantitative information available, whether it might be better to use demographic metrics as proxies for some types of qualitative knowledge, and examples of the use of qualitative information in practice. It will also be difficult for analysts to integrate EJ into the planning of a risk assessment when the EJ purpose or goal is not specified at the outset. Analysts need guidance on determining appropriate goals at the outset of the analysis, and defining what metrics are appropriate for assessing progress or attainment of these goals.

A more robust description of methods for combining quantitative and qualitative data for analysis of EJ concerns and issues should be included in the draft EJTG. When attempting to use the best available information (both qualitative and quantitative) to inform decision-makers, it is not clear what is considered acceptable to include in an analysis with respect to qualitative data. This concept needs to be defined or described to improve clarity. If the goal is to synthesize or otherwise combine or integrate quantitative and qualitative data, insights may be provided by the decision sciences. There is an influential literature on developing objectives and performance measures for data that may be otherwise characterized as "qualitative" (Bond *et* *al.*, 2008; Keeney *et al.*, 2005). While instruments such as story maps may help to characterize qualitative information, they may not be as useful to decision-makers as tools developed for aiding with the decision-making process.

A decision tree-type schematic may be helpful to demonstrate the points or stages in the process of addressing EJ concerns, including community knowledge, or utilizing community-generated data to help fill in critical data gaps. This recommendation is particularly relevant based on the interest and apparent need to better integrate quantitative and qualitative data and to better understand the local context even when conducting national scale assessments. California's AB 617 Community Hub 2.0[8] is a state-hosted resource whereby communities can share qualitative information which is supplemented by the California Air Resources Board's quantitative monitoring data. This resource allows different types of cultural or other anecdotal data to be aggregated with more quantitative data.

Regarding characterization of risk, and exposure and outcomes within each defined population group, the guidance to use the extreme portion of the effect distribution is sensible to be as protective as possible, but the SAB notes that the ways in which to operationalize this approach are not clear. For example, how is the upper tail defined, and how does this definition vary for non-normal distributions, such as those that are highly skewed or multi-modal? It is also not clear how intra-group distributions should be analyzed. That is, should the distributions within population groups be compared to the distribution for some comparison population groups (like a "baseline")?

Additionally, the SAB finds that comprehensive guidance on defining population groups, or the populations of concern, is lacking in the draft EJTG, particularly in achieving consistency with E.O. 14096. Chapter 2 clearly defines populations of concern: "An EJ concern is the actual or potential lack of just treatment or meaningful involvement on the basis of income, race, color, national origin, Tribal affiliation, or disability status in the development, implementation and enforcement of environmental laws, regulations and policies," based directly on the very specific definition provided in E.O. 14096: Sec. 2. Definitions. This list of populations of concern is very specific but seems to apply to the individual level ("people").

The draft EJTG analysis, however, does not place any special emphasis on assessing EJ issues with respect to the groups identified in these definitions. One approach would be to use the social dimensions of environmental injustice identified in the E.O. 14096 (i.e., income, race, color, national origin, Tribal affiliation, or disability) to define 'Priority 1' groups, then refer to other groups/categories/communities explicitly identified in E.O. 14096 (i.e., Effect Modification Categories, etc.) as 'Priority 2' groups. E.O. 14096 is explicit in defining advancement in EJ as dependent upon operationalizing and enforcing all civil rights laws (Section 1. Policy second paragraph), suggesting its use in identifying potentially relevant populations of concern. The reliance on "civil rights laws" suggests a variety of characteristics

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[8] See https://gis.carb.arb.ca.gov/Portal/apps/experiencebuilder/experience/?id=fa898fba4d024c568d7e228b83cd1246&page=Home&views=View-10%2CView-32

might be included in defining population groups - race, color, religion, sex or national origin, age, disability, and people in institutions such as prisoners and residents in government-run nursing homes. Should all civil rights laws be considered in identifying additional populations of concern for EJ analyses to inform national rulemaking? Overall, more explicit guidance about how population groups should be identified and prioritized is needed.

Executive Order 14096 also suggests the relevance of environmental housing conditions and climate impacts (Section 1. Policy: fourth paragraph) as well as, lack of resources, language barriers, tribal sovereignty, subsistence practices, ways of living, IK and traditions (Section 1. Policy: sixth paragraph). The draft EJTG does not provide clarity on how to integrate such considerations in defining population groups or how to consider these factors in an EJ analysis.

The SAB recommends that the draft EJTG provide more clarity for identifying populations of concern. For example, does the "Subsistence Populations" definition include Amish or similar groups of people? Similarly, should geographically dispersed and mobile populations, such as migrant farmworkers be included? Should the present population of Home Owners' Loan Corporation (HOLC) neighborhood graded areas be included?

Some SAB members suggested additional population characteristics that are beyond those in the draft EJTG or included in E.O. 14096. Employment/occupation status could be used to characterize inequities in exposure to environmental stressors and potential communities' adaptation and mitigation responses. Farm workers and construction workers are often exposed to higher pollution concentrations and higher temperatures compared to other occupations. Housing status was suggested as a variable to consider as it may be related to higher exposure to pollution in some, and populations with poor quality housing may lack access to public services that can make them more vulnerable.

The requirement to address EJ with meaningful involvement suggests that a wider group of stakeholders should be included or considered than is sometimes used in an EJ analysis and requires a fuller discussion of what this term means. The reference to baseline EJ concerns is important, but these "concerns" are not defined. Finally, the goal of emphasizing intersectionality (e.g., how systems of oppression and discrimination interact with each other, such as race, gender, socioeconomics and more) is difficult to operationalize as this is an individual level characteristic and it is difficult to understand how one might characterize it for specific groups. The SAB notes that in Chapter 3.2 'Identifying Objectives, Data, and Other Information' footnote 31 appears to place peer-review above all other examples; this seems appropriate, but the footnote appears to minimize the need for community input or places it subservient to all other examples.

Text box 3.1 in the draft EJTG, 'Current Best Practices for Evaluating EJ Concerns,' contains useful and wise guidelines for analysts. First, the wording of the suggestions often uses the phrase "analysts are encouraged to…" when referring to the very best practices that are the purpose of this list. The SAB notes that EJ analyses would be clearer and more consistent if the directives were worded as "should" or "are required" instead. In cases where a specific directive cannot be followed or is not feasible, the analysts should explain why they did not or were not able to adhere to best practices.

Because every aspect of an EJ analysis is influenced by data quality, an expanded discussion and more specific guidelines are recommended. Data quality metrics beyond accuracy, such as precision, error, and uncertainty should be considered in any EJ analysis and documentation should be required. This is especially important in cases where multiple datasets of different resolution, time, accuracy, etc. are analyzed together. Best practices should be more explicit about these data characteristics. The SAB encourages the EPA to include the use of a sensitivity analysis to explore data quality effects and their impact on outcomes.

The SAB has some concerns regarding the use (or absence) of data validation in the context of evaluating data quality; approaches such as ground-truthing, evaluating accuracy of address-matching and geocoding, and the common problem of misrepresenting pollution sources geographically. The latter often arises when some features that are multi-dimensional are represented geospatially as points, as well as when characterizing non-point sources – a problem that is more acute in non-urban areas and for certain types of pollution sources, such as oil and gas development sites. Data validation is of critical importance to a meaningful EJ analysis for contextualizing data in various formats, of varying quality, as well as other types of data necessary to make such analyses complete. Furthermore, best practices should be explicit about how data of value to a particular analysis, but are not nationally consistent, are to be used. One example is disaggregated infrastructure/emitters like oil and gas wells or waste disposal wells. Case studies should be provided on how to implement the guidance.

The SAB notes that the draft EJTG should provide best practices regarding the use of maps in EJ analyses. Maps have tremendous potential for data exploration and pattern analysis, as well as to communicate information and conclusions effectively and clearly. However, they also have the capacity to mislead if not created with good cartographic practices. Because most people, particularly non-technical users, generally do not question the accuracy of maps as they might the accuracy of text, extra attention is needed to make certain that maps are carefully and accurately constructed.

The selection of a geographic unit of analysis is consequential to the results of a spatial analysis and the meaning of the results, so guidance on how to choose the appropriate unit should be added. There is published research to refer to in developing this guidance (e.g., Baden *et al.*, 2007; Banzhaf *et al.*, 2019a). If EPA has some current guidance to address this concern, it should be more explicitly included in the draft EJTG. Similarly, characteristics of the "baseline" condition can significantly affect analytical interpretations and outcomes. The SAB recognizes that, in some cases, defining the baseline for comparison will be difficult due to a lack of information or paucity of information. Like the selection of the unit of analysis, guidance on how to define the baseline is needed, as well as examples of cases where information is not optimal for making this determination. Examples to consider include the city of Detroit, Houston Ship Channel, and Appalachia as instances of well-drafted long-term impacts where baseline data do not exist.

In considering economic challenges for relevant population groups, the SAB is uncertain as to whether the focus of this recommendation is only on increased costs to the population groups of concern, or if it is meant to evaluate economic effects more broadly. E.O. 14008 calls for consideration of how low-income populations are affected by price increases, or to consider the distribution of economic costs more broadly from an EJ perspective. The SAB also notes that there are circumstances in which economic evaluation might complement EJ objectives, but others in which equity and economic implications may be in conflict.

The SAB recommends that the draft EJTG clarify if the proposed economic analysis is intended to focus only on price increases (or other economic impacts) of proposed regulatory actions that may negatively affect already overburdened communities. Executive Order 14008, indicates that "it may be appropriate to consider how low-income populations are affected by price increases or to consider the distribution of economic costs (e.g., private and social costs) more broadly from an EJ perspective." While results from the two types of analyses may be complementary in supporting EJ objectives (e.g., which could be used to provide mitigation or resources to support potable water system upgrades to provide a disadvantaged community with access to cleaner water), in some cases, EJ and economic analysis results may be in conflict. The consideration of economic effects used in Human Health Risk Assessment (HHRA) could provide guidance.

One final best practice which is not technical but remains vitally important is to make reporting on EJ assessments as straightforward and easy for the public to understand as possible. This includes the use of the appropriate language to provide access to communities with significant linguistic isolation. The SAB recommends a link to an actual "public facing" EJ assessment that can serve as an example for analysts to follow.

Charge Question #4 – EJ Contributors and Drivers

Chapter 4 provides a brief overview of the contributors and drivers of greater risks and health effects from environmental stressors for population groups of concern. Does the discussion of contributors and drivers adequately reflect the state of the literature? Is it clear and technically accurate?

The SAB notes that the discussion of contributors and drivers of greater risks and health effects in the EJTG is limited. The SAB provides several recommendations to expand and clarify the current examination of these issues.

Recommendations:

Tier 1

- The SAB recommends identifying how an analyst should consider intrinsic and extrinsic factors when performing a risk assessment.
- The SAB recommends discussing the roles of "structural racism" and "systemic racism" in environmental protection.

- The SAB recommends emphasizing the role of climate change in exacerbating the disproportionate exposure by EJ communities to multiple stressors and cumulative exposures.
- The SAB recommends expanding the discussion on meaningful engagement with all stakeholders that can strengthen the understanding of contributors and drivers of risks and health effects from environmental stressors.
    - Explicitly acknowledge the role of the states in co-regulating with the EPA.
    - Explicitly recognize Indigenous Knowledge, Traditional Ecological Knowledge, local community knowledge, Lived Experience, and Indigenous People, who could co-implement strategies to address disproportionate exposures.

Chapter 4 provides an overview of the contributors and drivers of greater risk and health effects from environmental stressors for population groups of concern and the uneven distribution of environmental health risks across population groups. The revisions to the chapter included characterizing vulnerability as a function of intrinsic and extrinsic factors (defined in Chapter 2); climate change as a contributor to higher exposure and susceptibility; and adding differential monitoring, compliance, and enforcement as a potential contributor to higher exposure.

The SAB agrees that Chapter 4 is concise, and logical, yet inconsistent with the current literature on contributors to EJ concerns. Chapter 4 is the shortest on page length and subsections (includes 4.1 & 4.2 only). Much of the discussion is rooted in the social construct of race and other social determinants rather than heredity or genetics that rely on biology. There is consensus that an expansion and greater depth of discussion of several ideas, that are minimally presented, are needed. The grouping of extrinsic and intrinsic factors is highlighted, as is the specific explanation of the key contributors that fall into each respective group. Guidance for the analysts should be more explicit requiring that factors of EJ concern be technically accurate, implementable, and useful for advancing environmental justice science issues. The organization of factors into specific considerations in the draft EJTG could serve as a useful basis for an EJ analysis framework.

Chapter 4 explains that cumulative impact assessment can involve various chemical and non-chemical stressors. It is important to identify the population of concern based on the cumulative impacts and consider how regulatory intervention will affect the identified risks. However, including diverse risk factors while identifying the population of concern can be problematic if the proposed regulatory intervention will have a limited impact on the main risk factors identified in the population of concern. In other words, the more risk factors used to identify the population of concern, the harder it will be to show that one regulatory intervention will have a meaningful impact on the community risk profile. The SAB offers the following specific advice for each sub-section of Chapter 4 to enhance clarity and completeness of the draft EJTG.

On page 20, in describing the term “overburdened,” the draft EJTG identifies contributors to increased risks including, “… greater vulnerability and/or susceptibility to environmental hazards, lack of opportunity for public participation, or other factors." The term "other factors" is vague and could benefit from elaboration to include multiple major sources and media (e.g., air, water, and soil concerns in specific overlapping geographical areas) and possible lack of access to information and coordination from governmental agencies and other jurisdictions. In a related context, on page 20, the draft EJTG states that race/ethnicity is a social construct that captures the complex interplay of social vulnerability factors that drive environmental health risk (Morello-Frosch *et al.,* 2011); however, the SAB notes that the connections within cumulative impact contexts should also be mentioned. By linking more vulnerable populations and cumulative exposures into the context of cumulative impacts and less resiliency, the analyst is better able to assess factors that are not included in current risk assessment methodology. Cumulative risk assessment is also currently inadequate as each chemical risk is assessed in isolation (i.e., one chemical at a time).

Similarly, the draft EJTG does not mention nor account for geogenic (not climate-related) occurring hazards such as radon, earthquakes, asbestos, or arsenic that may be additional stressors (Erickson *et al.,* 2018, 2019). To put it another way, the analyst could ask, "are there geogenic concerns that, in addition to the proposed rule, could exacerbate the burdens of an EJ community?" Naturally occurring arsenic or other elements in groundwater, for example, could be an EJ issue for rural areas that rely on groundwater because there could be an impact on the treatment process. Drinking water treatment costs could increase and become burdensome for a small community water system. These concerns may occur for naturally occurring chemicals as well as man-made environmental issues. North Dakota and Iowa, for example, have the highest levels of naturally occurring radon in the country. A proposed rule that impacts a low-income resident or renter's home in these states with naturally occurring elevated radon levels may exacerbate EJ concerns. Providing a more specific structure to the analysis and guiding the analyst to examine the major considerations would be helpful. Allowing for flexibility in addressing regulation or community-specific concerns is important, but there would be some value in promoting a more consistent and predictable analysis as a starting point and then supplementing the analysis with regulation/community-specific evaluation as needed. Such an approach would be more consistent with how human health risk assessments are currently conducted. The preferred method to incorporate this concept in the draft EJTG would be a separate section in 4.1 that incorporates extrinsic geogenic effects. Alternatively, the concept could be incorporated into section 4.1.2, Unique Exposure Pathways, or Section 4.1.4, Exposure to Multiple Stressors and Cumulative Exposures.

<u>Section 4.1 Contributors to Higher Exposure to Environmental Hazards</u>

Extrinsic factors are briefly presented in Section 4.1. The current opening juxtaposes "intrinsic" and "extrinsic" in the opening paragraph. To enhance clarity, the definitions in Chapter 2 should be re-addressed. On page 20, footnote 34 states that extrinsic factors may relate to current and historical mechanisms that operate through the labor market, real estate market, educational system, political institutions, and cultural and societal values to reinforce social hierarchies based on race, ethnicity, income, occupation, age, or other characteristics (NASEM, 2016; Solar and Irwin, 2010). These extrinsic factors are currently not included in an analyst's considerations for risk assessment. A list as an appendix of what the EPA considers extrinsic factors would support the consideration of cumulative impacts more formally. The same is true for intrinsic factors and its current lack of inclusion as considerations for risk assessment. Footnote 35 on page 20, implies that intrinsic and extrinsic factors are what constitute non-chemical stressors. Specifically, it states, "Differences in outcomes due to intrinsic and extrinsic factors related to economic, demographic, social, cultural, psychological, and physical factors are sometimes also referred to as non-chemical stressors (NASEM, 2023)." It is not clear how an analyst should consider these intrinsic and extrinsic factors when performing a risk assessment. Given the extent to which this document is meant to guide analysts and the importance of non-chemical and chemical, and extrinsic and intrinsic factors, these terms need more than defining in footnotes and in the glossary.

The Introduction of the draft EJTG, includes the term "structural racism" on page one with a quote from Administrator Regan. "Systemic racism" then appears on page 15 of the draft EJTG document, but no elaboration or definition is provided. Structural racism is also mentioned in Chapter 4, page 22; definitions for the terms "structural racism" and "systemic racism" are warranted and require more discussion. As noted above, the footnote listing extrinsic factors as historical mechanisms such as "labor and realty markets, educational systems, political institutions, etc." is essentially another way to express "structural racism."

The SAB recommends inclusion of information on the role of structural and systemic racism in the history of environmental protection in Chapter 4 as it provides contextual understanding; for example, there are only twenty-six monitors in the nation for air toxics monitoring (see Appendix B of this report) whereas there are far more emitting sources. The role of structural racism is also evident in discriminatory zoning, e.g., there are more exposures from facilities in overburdened communities. Other notable concerns of structural racism that add to contributors and drivers of greater risks and health effects from environmental stressors for population groups of concern and the uneven distribution of environmental health risks include inequitable access to green spaces and healthy foods (food deserts), poor quality rental housing, and unsafe water. As Chapter 4 builds on terms from Chapter 2, "[s]ystemic racism emphasizes the involvement of whole systems, and often all systems—for example, political, legal, economic, health care, school, and criminal justice systems—including the structures that uphold the systems" according to Braveman *et al.,* (2022, p. 172). They continued, "[s]tructural racism emphasizes the role of the structures (laws, policies, institutional practices, and entrenched norms) that are the systems' scaffolding." Further elaboration of a theory of structural racism can be found in Bonilla-Silva's 1997 paper.

Systemized guidance by EPA might include background on past policies that reframe "structural racism" with a summary of the "political economy of environmental injustice" using that as a subtitle and drawing on three different sources. Evan Ringquist's 2004 chapter titled "Environmental Justice" in the widely adopted *Environmental Policy: New Directions for the Twenty-First Century* (Vig and Kraft, 2004) text offers several structural causes of environment inequity. After rejecting scientific rationality explanations, Ringquist discussed (1) market rationality; (2) neighborhood transition; (3) political power disparities; and (4) explicit discrimination. Likewise, H. Spencer Banzhaf's edited anthology on *The Political Economy of Environmental Justice* offers another set of related structural explanations: (1) explicit discrimination by firms; (2) industrial neighborhood transitions or "coming to the nuisance"; (3) firms seek out communities where less political resistance is likely; and (4) governments fail to enforce environmental standards and regulations equitably.

Figure 2. Social Equity and Public Health

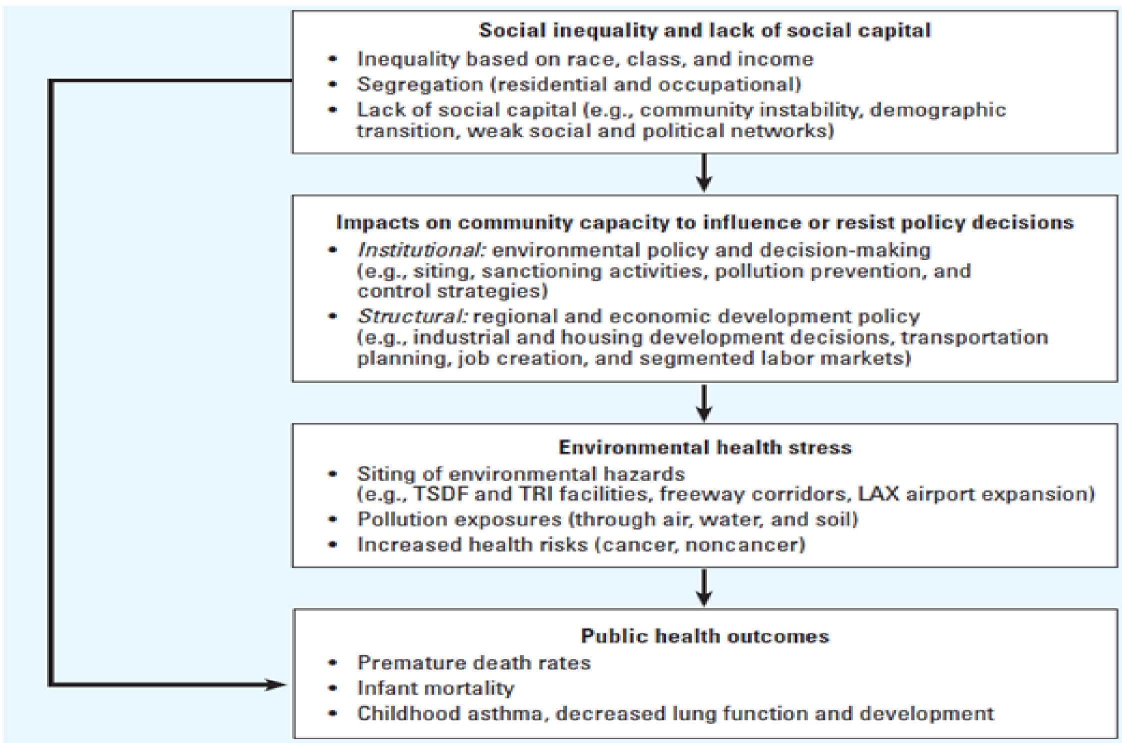


Figure 4. Political economy of environmental inequality. **(extracted from Morello-Frosch *et al.*, 2002)**

A California research group also proposed a political economy and social inequality framework which considered "how institutional discrimination interacts with larger structural forces" (Morello-Frosch *et al.,* 2002, p. 153). In the same section of their publication, the researchers presented a "Political Economy of Environmental Inequality" Figure 2 (above) [i.e., Figure 4 extracted from Morello-Frosch *et al.,* 2002] that can serve as a useful framework describing the relationship between social equality and public health, although it does not include all structural forces, such as lack of health care access, or markets as a structural cause of inequity. The SAB recommends adding this figure to Chapter 4 along with some narrative exposition. Further elaboration of a theory of structural racism can be found in Bonilla-Silva's 1997 paper.

Section 4.1.1 Proximity to Emissions and Discharges from Nearby Sources

On page 21, the draft EJTG states: "proximity to an emission source does not account for what or how much is being emitted or discharged from a source, how and where the pollutant travels as it moves through the environment (i.e., fate and transport), the time-activity patterns of individuals, and other key determinants of exposure." While more accurate exposures cannot be quantified without a refined exposure assessment, it is well documented that historically marginalized populations such as communities of color and Indigenous populations experience disproportionate exposures to environmental pollution (Estien *et al.*, 2024). Past government policies (such as redlining) contribute to vulnerability and susceptibility of historically marginalized communities of color. The practice of redlining put communities of color in closer proximity to emissions and discharges from nearby sources; and vulnerability and susceptibility are known to be higher due in part to a lack of access to public participation, resources, health care, and more.

<u>Section 4.1.2 Unique Exposure Pathways</u>

As noted earlier, some SAB members recommend the addition of geogenic factors such as radon and/or lead in older housing, for example. Such geogenic factors may contribute to cumulative exposures, vulnerability, and susceptibility.

<u>Section 4.1.3. Physical Infrastructure</u>

In the built environment, physical infrastructure may be considered a nonchemical stressor, which could contribute to outcomes from systemic racism. This includes the proximity to highways or quite often urban EJ corridors that are hemmed in by highways on multiple sides. Related transportation infrastructure that contributes to uneven distribution of chemical and nonchemical exposure include rail and pipelines.

<u>Section 4.1.4 Exposure to Multiple Stressors and Cumulative Exposures-</u>

It would be helpful to refer to a specific matrix that categorizes potential stressors into categories, such as climate-related issues, nearby industrial sources, occupational exposures, sources of stress, diet, and lifestyle, etc. Each of these categories has specific issues that need to be considered. In this matrix, it would also be instructive to note which factors are quantitative *versus* qualitative and which tools are recommended for conducting the specific factor analysis.

The draft EJTG should emphasize the role of climate change in exacerbating the disproportionate exposure to multiple stressors and cumulative exposures. Often times communities on the front-lines of climate change experience concurrent stressors such as (1) the urban heat island effect, (2) food insecurity / food deserts, (3) policing and surveillance, (4) less access to parks and greenspaces, (5) higher levels of flooding, proximity to combined sewer overflows (CSO), and more precarious source of power during storm events; and (6) consent decrees that have potential EJ implications.

Section 4.1.5 Monitoring, Compliance and Enforcement

Extrinsic factors are only part of potential systemic barriers an EJ community could face, and an analyst may wish to consider. Monitoring, compliance, and enforcement may potentially be related if a state has or has not incorporated EJ in statutes or policies. A potential concern (and cause) could be local jurisdictional issues related to zoning for example (Mohai and Saha, 2015).

As technology continues to evolve and there are efforts to consider EJ concerns at multiple levels, improving resolution of data at a more local scale appears to be well-poised as a near-term goal. One example is the disproportionate PM2.5 distribution in overburdened communities compared with "control" communities. There may be inadequate regulatory monitoring coverage in rural areas, tribal lands, and under-resourced EJ communities to adequately inform analysts. In the context of inadequate monitoring data for compliance and enforcement considerations, analysts would be more informed with an understanding of how to incorporate local air quality measurements into the overall context of compliance and enforcement as they are tools to mitigate some air pollution in EJ communities. As far as the brief discussion of compliance is concerned, permitting is another tool to mitigate air pollution, which is seldom mentioned in the draft EJTG. Permits and compliance are connected tools used by risk managers, which warrants further discussion for an analyst's understanding.

Section 4.1.6 Community Capacity to Meaningfully Participate in Decision-Making

The SAB notes there are several efforts to collect data locally, which are not acknowledged and may contribute to the underestimation of actual exposure. This topic is addressed in Chapter 5 and could be referenced in this section as well. Local data and IK should be recognized in risk analysis as it adds to contextualizing EJ concerns in lived outcomes and impact on life experiences. Similarly, the SAB affirms the need for more discussion on meaningful involvement. Meaningful involvement is connected to the larger concern around the incorporation of other forms of data and community knowledge into EJ analyses (including qualitative data), which might improve exposure estimates in general.

As communities across the country and various states have different capacities to engage and participate in decision-making, this section is linked to community-based participatory research (CBPR) in locations where the understanding of pollution burden could be improved by meaningful engagement. Meaningful engagement is participation linked to civic engagement and CBPR. As understanding of cumulative impacts evolves, community capacity should evolve at the local level to the state/regional level, which can inform the national level.

Section 4.2 Contributors to Higher Susceptibility

The SAB has concerns over the lack of explicit acknowledgement of the states' role in co-regulating with the EPA, which is missing from the rulemaking process. Footnote 40, page 23, states: "In the context of enforcing federal environmental regulations, enforcement is a shared responsibility of federal and state governments. This requires cooperative, periodic, and early joint planning and regular communication between the EPA and states on the sharing of enforcement responsibilities."

States can provide critical recommendations, opportunities for collaboration, and agreements. The cooperative federalism model as outlined in the Environmental Council of the States (ECOS) Whitepaper, Cooperative Federalism 2.0[9], explains the roles and responsibilities of the states and federal partners. Of particular importance is the adequate funding of state's programs, if they choose to implement the federal program and have the primacy to do so as well as the engagement of states "early and often." In the case of EJ Analysis in Rulemaking, utilizing preliminary discussions about proposed rulemaking with states could be advertised via various listservs such as EPA's EJ, ECOS's EJ, and NEJAC. Another example of state-federal partnership is the upcoming "Environmental Information and Innovation Meeting"[10] that is being co-hosted by the ECOS and EPA. More examples include the National States Geographic Information Council (NSGIC), International Conference on Environmental Data Management (ICEDM), National Environmental Justice Conference and Training Program[11] and Interstate Technology and Regulatory Council (ITRC) which are also valuable information sharing venues between and among states, community and federal organizations. Utilizing existing national or regional conferences of these organizations may also be a valuable way to share and exchange information and encourage states and their partners.

As a guidance document, the EJTG should provide a more inclusive list of definitions (e.g., in Chapter 2) along with the most important considerations and criteria that fall under each factor (not just examples). Such an addition could serve as an initial "checklist" for conducting an EJ analysis. While analysts may offer justification for the evaluation of more factors, it would be useful to have a common starting point of core considerations. It is also important to clarify how the results of EJ analyses will be used to inform regulatory options. It is challenging to develop effective strategies to support EJ goals and regulatory options without knowing how the information is being used in the development of decisions.

The SAB notes that framing of issues in context is useful, and there is value in promoting a more consistent and predictable analysis process for analysts. The chapter lacks specificity as to the specific factors that should be assessed. The draft EJTG describes key considerations for conducting an EJ analysis, clarifies confusing concepts and breaks down the analysis into more manageable parts. However, the draft EJTG lacks a clear framework or step-by-step process for conducting an EJ analysis. If EJ analyses are to play a role in informing regulations, they need more structure, rigor, and consistency. A structured analysis, with the option to be flexible as needed (with proper justification), would promote high-quality, scientifically valid assessments that reliably support health-based regulations. The lack of structured guidance results in incomplete and random analyses that fail to balance all relevant interests.

[9] See https://www.ecos.org/wp-content/uploads/2017/06/ECOS-Cooperative-Federalism-2.0-June-17-FINAL.pdf
[10] See https://www.e2imeeting.net/
[11] See https://thenejc.org/

Charge Question #5 – EJ in Human Health Risk Assessment

In Chapter 5, are there additional technical considerations that should be enumerated to start integrating EJ considerations into the planning phase of human health risk assessments (HHRA)? Do the scoping questions in section 5.3.2 adequately identify opportunities for incorporating environmental justice into a HHRA?

As the EPA develops strategies for integrating environmental justice considerations into human health risk assessments, the following recommendations highlight issues that should be addressed.

Recommendations:

Tier 1

- The SAB recommends that analysts define the goal and purpose of the EJ analysis to plan the analysis, including how to frame the questions, which datasets to use, which analyses to perform, and how to synthesize and interpret results.
- The SAB recommends clarifying how to select and examine populations of concern.
- The SAB recommends clarifying how to identify baseline EJ concerns.
- The SAB recommends providing more guidance on how to choose the baseline period, especially for contexts where data are sparse or absent.
- The SAB recommends stressing the importance of meaningfully engaging affected parties and being specific about how participatory science can inform HHRAs.

Tier 2

- The SAB recommends describing how new science on interactions between stressors fits into the HHRA process.
- The SAB recommends providing more detail about cumulative risk assessment and cumulative impacts analysis and their relationships.
- The SAB recommends clarifying what chemical and non-chemical stressors are and providing examples of how to incorporate non-chemical stressors in EJ analyses.

Chapter 5 discusses modeling and data needs, stages in a human health risk assessment (HHRA) where EJ issues should be considered, and multiple exposures and cumulative impacts. Section 5.3.2 highlights three scoping questions for incorporating EJ into a HHRA:

1. Which population groups, as characterized by geographic location, ethnicity or race, gender, occupation, age, baseline health status or other factors, should be part of the assessment?

2. What health endpoints are to be addressed by the assessment?

3. What exposure routes and pathways are relevant, do specific exposure pathways potentially lead to specific effects, and what exposure scenarios should be modeled?

Chapter 5 is well-written and generally easy to read and understandable. It provides a broad review of the steps involved in HHRA and how EJ factors are considered at each stage, though not necessarily sequentially. It is quite general with a few case studies demonstrating how different approaches were implemented in specific regulatory contexts. Even with the case studies, few specifics of how to operationalize the guidance are offered. More detail on technical approaches and data are presented in Chapter 6. The information contained within Appendix B of the draft EJTG is useful and provides more detail on technical approaches and data. However, the SAB was unclear as to why relevant information was, in many cases, included in a footnote instead of in the text. EPA should consider moving such information to the main text so that it would not be missed. The SAB also identified several other opportunities for improving the chapter.

The SAB agrees that a clearer explanation of how the technical and broader engagement elements interact would be valuable. Technical considerations and broader engagement with the public and communities in the HHRA scoping process are inter-mixed throughout the chapter. For example, data and model challenges come before planning, scoping, and problem formulation in the chapter. Then, cumulative impacts are discussed without a clear segue.

The draft EJTG should direct analysts to define the purpose of the EJ analysis in the HHRA, as mentioned earlier in the SAB's responses (e.g. Charge Question 3). In Chapter 5, the draft EJTG currently addresses the purpose and scope of the specific policy/regulatory decision, statutory requirements, and risk management options. Defining the purpose of the EJ analysis specifically is necessary to plan the analysis, including how to frame the questions, which datasets to use, which analyses to perform, and how to synthesize and interpret results in the EJ chapter of a HHRA as well as in the Executive Summary. For example, the EJ analysis could be aimed at understanding whether the action would reduce harm to overburdened communities, reduce risk for everyone overall, maximize benefits for overburdened communities, or reduce the risk gap between overburdened and less burdened communities. Defining the goal of the EJ analysis should be a critical element of the scoping process.

The draft EJTG should integrate findings and knowledge from relevant EPA and White House documents dealing with environmental justice science. For example, important documents include: (1) the Environmental Justice Science, Data, and Research Plan developed by the Environmental Justice Subcommittee of the National Science and Technology Council (Environmental Justice Subcommittee), released in July 2024, per E.O. 14096; (2) EPA's new Meaningful Involvement Policy; and (3) Agency guidance on cumulative impacts assessment. For those documents not yet finalized, references should be added when they become available.

The SAB concludes that clarifying how to select and examine populations of concern and identify baseline EJ concerns would provide important guidance for analysts. The draft EJTG currently lacks clear, structured guidance for how to select and examine populations of concern. There are many executive orders and other EPA documents that specify individuals, communities, and populations of concern. The draft EJTG could be more explicit and address to what degree the relevant EJ executive orders should determine the selection of population groups. In addition, the draft EJTG is not clear about how baseline EJ concerns are identified. Incorporating language on approaches EPA may use to identify EJ concerns, such as compliance history or consulting with state public health and environmental agencies, would help analysts understand which environmental issues are of concern for which populations. More guidance on how to choose the baseline period would be helpful, especially for contexts where data could be sparse or absent.

The scoping questions outlined in Section 5.3.2 of Chapter 5 are relevant and provide valuable guidance consistent with existing EJ technical literature but could emphasize the intersectionality of some of these risk- or effect-modifiers or how different demographic characteristics might interact. Some population groups may experience higher baseline risks than others resulting from the intersectionality of environmental issues and demographic characteristics. The SAB also recommends that the draft EJTG emphasize the link between the timing of potential risks and the outcomes for exposed populations. For example, whether the resulting risk is expected to affect the population in the short term (e.g., within weeks or months) or in the long term (e.g., within years). This is important because environmental health literature has found differences in outcomes associated with the length of exposure to certain risks for specific populations. For example, exposure for pregnant women during certain gestational periods might present a greater risk than at other gestational periods (Currie *et al.,* 2013). Another important consideration are differential susceptibilities associated with exposures at various life-stages (e.g., children and elderly *versus* the general population). The timing of the exposure and the implications for exposed populations will likely be an important question that analysts should consider when deciding the type of data and tools that they will use when conducting a HHRA.

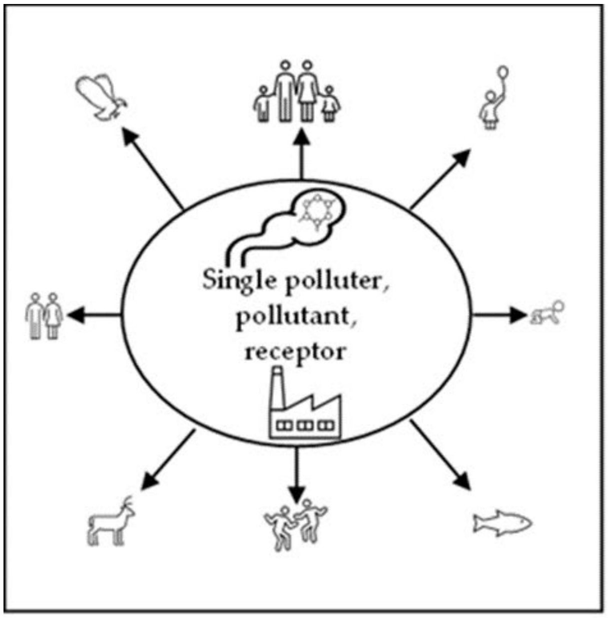
The draft EJTG, as previously noted by the SAB, should stress the importance of meaningfully engaging affected parties and be specific about how participatory science can inform HHRAs. The process of considering community concerns and data for local decisions that directly affect communities is better established; whereas the nature of community involvement in informing national regulations requires a more robust discussion in the draft EJTG, especially when the impact of regulatory decisions on environmental justice communities may be unequal. The section on Risk Management in relation to “Fit-for-Purpose” encourages “transparent dialogue between risk assessors and risk managers early in the assessment process.” This section should also explicitly include community leaders, emergency responders, sewer/water districts, and other examples of relevant parties that should be engaged meaningfully throughout the HHRA process. The SAB recognizes that it will not be possible to list every potential important party, but the text should be more inclusive of parties beyond risk assessors and risk managers. The draft EJTG should provide specific information on the type and amount of data required to inform and influence national regulations. For example, the EPA’s Handbook for Citizen Science Quality Assurance and Documentation (EPA, 2019) states that data for regulatory decisions should be quantitative and highly detailed.

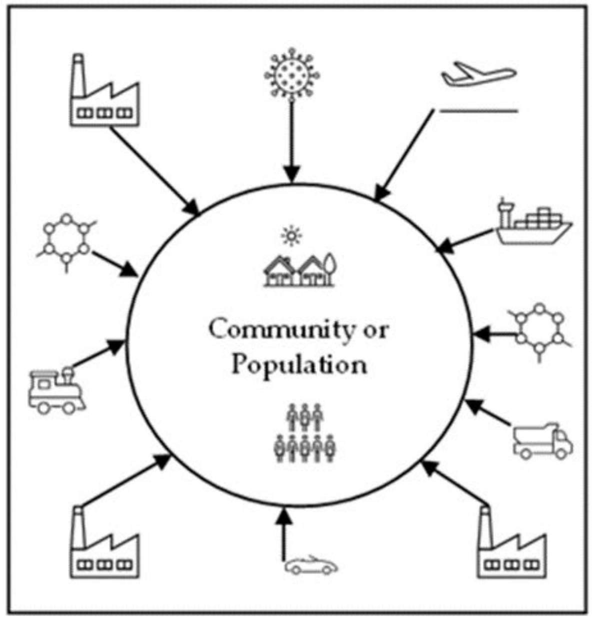
The SAB agrees that the draft EJTG should provide more detail about cumulative risk assessment and cumulative impacts analysis and their relationships. Chapter 5 should also include definitions, in addition to the glossary at the end of the EJTG, differentiating between health impact assessments (HIA) [as described in the text box on p. 47 of the draft EJTG] from the analyses of health benefits of reduced pollution exposure that EPA conducts routinely as part of Regulatory Impact Assessments (RIA). The SAB further explains that including a diagram showing the relationship between HIA and RIA would reduce possible confusion between the terms and concepts.

The draft EJTG should clarify what chemical and non-chemical stressors are and provide examples of how to incorporate non-chemical stressors in EJ analyses, which may be broad and more qualitative. Economic and financial stressors should be included in the Cumulative Risk Assessment section. EPA should consider providing examples showing how considering multiple stressors could be operationalized in a regulatory context that is targeting one exposure at a time. It would be valuable for analysts to have guidance on which additional stressors to prioritize, beyond the one targeted by the regulation, since resources and data are limited. The SAB suggests that Chapter 5 should address how new science on interactions between stressors fits into the HHRA process. Different government agencies have developed several indices to account for cumulative exposures (Bakkensen *et al.,* 2024). Examples of these indices are EPA's EJScreen and the CDC's Environmental Justice Index. Mentioning these tools and guidance on how to incorporate them into HHRA would allow the examination of the cumulative effects of multiple or dissimilar stressors.

The SAB agrees that the discussion of cumulative risk may warrant a graphical contrast with its antithesis such as the following. Chemical or stressor-focused risk assessments are displayed in Figure 3A below. Also referred to as a piecemeal risk assessment, analysts focus on just one source or chemical. Conversely, cumulative risk assessment displayed in Figure 3B below focuses instead on a geographic area potentially impacted by multiple sources.

Figure 3A- Single Source *Figure 3B-* Multi-Source





Adapted from EPA, United States Environmental Protection Agency. 2003. "Framework for Cumulative Risk Assessment." EPA/600/P-02/001F. Washington, D.C.: U.S. Environmental Protection Agency, Office of Research and Development, Center for Public Health and Environmental Assessment.

This distinction may be especially applicable to Hazardous Air Pollutant (HAPs) sources. Regulated by the National Emission Standards for Hazardous Air Pollutants (NESHAPs) in the 1990 Clean Air Act Amendments, only major sources are covered that release 10 tons per year of any of the 189 air toxics or 25 tons of any combination of air toxics. Non-major or area-sources of HAPS are left unregulated in many states. For example, if there are three industrial facilities in the same geographic area emitting 5 tons each of an air toxic or some combination, they escape regulatory scrutiny because no single facility meets the 10-ton single toxic or 25-ton combined toxics thresholds. Ignoring the cumulative impacts of multiple smaller sources leaves a regulatory gap for air toxics in most states. Thus, clusters of area-sources may contribute to localized hotspots and exemplify another form of structural racism.

EPA later addressed smaller or "area-sources" in 1999 with an Integrated Urban Air Toxics Strategy (EPA, 1999). These sources represent polluters emitting less than 10 tons of an air toxic or 25 tons of any combination. Yet in 2010, EPA's Office of Inspector General (OIG) found the program remained unimplemented. In particular, OIG reported that "although EPA determined in 2001 that a risk-based program is necessary to meet the goals of the Strategy, EPA has not yet determined whether it has the statutory authority to require State and local agencies to implement such a program" (EPA 2010). OIG analysts further concluded that "without the establishment of a minimum, federally required risk-based program, we do not believe that all State and local agencies will implement programs to adequately address the health risks from urban air toxics." In a 2016 review of the National Air Toxics Trend Sites

(NATTS) system, EPA analysts found that existing HAPs monitoring networks are incapable of assessing exposures below urban scales (Strum and Scheffe, 2016).

The SAB also provides several minor revisions that could improve the clarity of Chapter 5 (see Appendix A of this report).

Charge Question #6 – EJ in Regulatory Actions

In Chapter 6, are the analytical considerations for assessing EJ concerns in the context of a regulatory action appropriately identified and discussed? Are there considerations that should be added or removed from the discussion?

The SAB commends the work of the Agency in updating its 2016 EJTG and in particular the guidance provided in Chapter 6 on conducting regulatory analyses. The treatment of analytical methods, from preliminary analysis to defining baseline and options to discussions of data, methods, and other considerations is clear and balanced. Overall, the revised technical guidance that is provided is appropriately identified and discussed. Below the SAB offers some potential improvements for consideration.

Recommendations:

Tier 1

- The SAB recommends providing more structure and consensus data sources, so analysts are more likely to arrive at similar conclusions in similar regulatory contexts.
- The SAB recommends clarifying the purpose of conducting regulatory analyses to assess EJ concerns.
- The SAB recommends providing additional clarity regarding how the results of EJ analyses will be used to inform decision-making.
- The SAB recommends clarifying the purpose of the preliminary analysis and how results are used to inform the regulatory analysis, and in particular the role of screening tools like EJScreen.
- The SAB recommends identifying and describing the methodologies for conducting an EJ analysis, including providing a set of preferred data sources and tools, with additional sources of information being added by the analyst with sufficient scientific justification.
- The SAB recommends addressing selection bias and other confounding factors in any analysis designed to establish causal impacts.
- The SAB recommends that analysts explain why the comparison group provides a useful counterfactual to the population group of concern, how the two groups differ, and whether and why those differences might be important to the interpretation of results within the EJ analysis.
- The SAB recommends providing guidance for considering feedback over time and across space.

- The SAB recommends prompting analysts to consider multiple scales as a best practice when addressing the case of multiple stressors.
- The SAB recommends providing more guidance regarding how to deal with uncertainty (in data, estimates, predictions, and statistical methods), and that uncertainty should be transparently described in the results.

In general, the information provided in the draft EJTG is open-ended and subjective, reflecting more a strategy document than a structured guidance document. The draft EJTG stresses flexibility, but without more structure and consensus data sources, analysts are likely to use a wide variety of approaches and data and may arrive at substantively different conclusions, even when using the same data and in similar regulatory contexts. The SAB recognizes the heterogeneity of environmental regulations that the draft EJTG is designed to support and the difficulty of providing a comprehensive list of specific issues that an analyst should consider in each such context. Nonetheless, many of the SAB's comments are geared toward providing additional structure to support more systematic, consistent EJ analyses across rules and to acknowledge best practices across a spectrum of analytical approaches.

The SAB encourages the EPA to clarify the typical purpose of conducting regulatory analyses to assess EJ concerns. In the introduction to Chapter 6, the text states that the chapter "discusses how to assess whether a regulatory action has EJ concerns…," but the phrase "has EJ concerns" could use some additional explanation. This section of the draft EJTG should provide some additional clarity regarding how the results of EJ analyses will be used to inform decision-making. Without this clarity, it can be difficult for an analyst to build an appropriate methodology. For example, if the purpose of the analysis is purely descriptive, this would require a different approach than an analysis that aims to establish plausibly causal relationships between EJ community characteristics and environmental regulatory benefits and costs. If the results of the EJ analysis can potentially lead to a change in regulations, then it is crucial for the draft EJTG to specify which results are significant and if there are any relevant benchmarks for triggering regulatory action. However, if these analyses are simply intended to provide additional context to the regulatory impact assessment and do not guide regulations, then it is less important to specify significant results and action benchmarks. The SAB did not provide specific comments below regarding how to better clarify these issues in the draft EJTG, but it would be helpful to include such clarification in the introduction of the EJTG and perhaps in other chapters, in addition to repeating this information at the beginning of Chapter 6.

The EPA should also ensure that the examples of EJ analyses that are provided throughout the draft EJTG follow best practices and represent rigorous EJ analyses. These examples will likely be construed as applied Agency guidance for EJ analysis, whether they are meant to play this role or not.

Section 6.1. Preliminary Analyses of EJ Concerns

The EPA is proposing to review various data sources to identify the extent to which there are EJ concerns in the baseline and offer initial insights into whether a regulatory action is anticipated to raise EJ concerns. This evaluation seems to be tied to a hypothesis-generating or problem-formulation step that aims to determine the type of assessment that is relevant and feasible. Further, in Section 6.1 of the draft EJTG, the EPA seems to be directly linking the preliminary analysis and the baseline analysis. However, in Section 6.2.6, EPA points out screening tools that may be helpful for the preliminary analysis. It is, however, unclear if the screening tools are only part of the preliminary analysis or part of the primary assessment to support regulatory options. The EPA should clarify the purpose of the preliminary analysis and how results are used to inform the regulatory analysis, and in particular the role of screening tools like EJScreen.

Section 6.2. Defining Baseline, Regulatory Options and Incremental Changes

The EPA claims that the baseline analysis can inform whether pre-existing environmental conditions and health effects are associated with the stressor. However, this statement is too strong, as it would be difficult to attribute any health conditions to a specific exposure, even if the baseline analysis shows a risk exceedance in an area. Similarly, the draft EJTG states that the outcome of the third step of the analysis (e.g., mitigation or exacerbation of impact) is that "Incremental changes reflect the improvement or decrement in effects of stressor(s) on specific populations that can be attributed to the regulatory options." The EPA should define what is meant by incremental change. For the vast majority of chemical exposures, the type of analysis that would need to be performed to demonstrate an "incremental change" in health effects is beyond the scope of the EJ analysis as presented in the draft EJTG. To measure such an effect, causation would first need to be demonstrated, followed by an analysis of the fraction of the health effect attributed to the specific exposures. The EPA needs to clarify that "incremental change" will often mean a change in exposure or risk under the different regulatory options (e.g. collocation of reduced concentrations with other exposures and social stressors). These chemical exposures are considered in traditional risk assessment paradigms under conditions that are inconsistent with lived-experiences; lived-exposures include non-chemical stressors, such as social determinants of health as well as minimal to no pathway for an individual to reduce cumulative environmental exposure risks that affect health outcomes (Reams *et al.,* 2019; Van Horne *et al.,* 2023).

In describing how to define the baseline in Section 6.2, a discussion of the potential benefits of conducting a cumulative impact assessment to evaluate the broader environmental, health and socioeconomic conditions that currently exist is warranted. Furthermore, accounting for the attributes that are important to the community as well as to the Agency is also needed. This would allow for the consideration of unique vulnerabilities that may make exposed sensitive sub-populations such as elderly people, children, and/or pregnant people more susceptible to increased emissions.

Section 6.3. Data and Information to Address EJ Concerns

The SAB agrees that EPA should provide a set of "preferred data sources." In section 6.3, the EPA states that; "The U.S. Census Bureau is the recommended source for demographic data used in an EJ analysis for rulemaking." While other tools are mentioned by way of example, the EPA should put together a more comprehensive list of recommended data sources and tools that could be a "first stop" in any assessment, with additional sources of information being added by the analyst with sufficient scientific justification.

The SAB recognizes that the quality and extent of available data can vary depending on the specific regulatory planned action. Section 6.3 should provide more information on how the quality of data can affect the strength of the analysis and the ability to inform regulatory options. For instance, using proximity data can be useful for screening purposes but it often cannot measure specific exposures. Thus, proximity analyses have limitations for informing how specific regulatory actions can impact risk in particular communities.

The SAB observes that Indigenous Knowledge, while mentioned throughout the draft EJTG, is noticeably missing from Section 6.3. This is curious as IK is mentioned throughout the document, except in this section regarding data. If access to IK is available, it can be an important component of an EJ analysis and identification of EJ concerns and should be included in Chapter 6. The SAB suggests that EPA explore the ideas in Hill *et al.*, (2020) as it provides a useful review of an international framework for incorporating IK into “western science.”

Section 6.4. Analytic Methods

The SAB suggests that Section 6.4 of the draft EJTG, where the discussion of best practices for EJ analyses listed in text box 3.1 (Chapter 3) recommends that analysts use the best available science, should be expanded. The SAB recommends that Section 6.4 guide the analyst by identifying and describing the methodologies for conducting an EJ analysis. In Chapter 6, centroid versus areal apportionment methods are the only methods discussed in detail. In multiple instances Chapter 6 refers to multivariate regression as a common method to employ for an EJ analysis; however, methods more advanced than multiple regression have been proposed in the literature for exposure assessment as well as for assessing the health impact of environmental exposures. The SAB recommends that a discussion of studies, for example, by Gelfand *et al.,* (2019) and Lawson *et al.,* (2016) be included in Section 6.4 to illustrate methods that explicitly account for spatial correlation and Kuminoff *et al.,* (2010) to explain multiple regression in greater detail, including regression approaches to address spatial autocorrelation.

Ideally, a broader discussion about the challenges of spatial data, including recognizing spatial autocorrelation and implications for statistical inference, as well as for descriptive statistics (e.g., assumption of a normal distribution) would be added. The draft EJTG should clarify that whether to address spatial autocorrelation and by what method depends on the goal of the analysis (e.g., prediction or testing the significance of an estimated effect *versus* distinguishing correlation from causation). If the goal of the analysis is prediction, the analyst can use spatial autocorrelation to predict what the exposure level would be for instances where data are sparse or missing. If the goal is to determine the statistical significance of an effect, then spatial autocorrelation increases the uncertainty of the estimate, and the analyst should use appropriate methods to correct for this. The draft EJTG could also mention that ArcGIS has a rich set of tools for doing spatial statistics (e.g., it allows non-parametric methods to account for the non-normality of the data).

Human health risk assessment (HHRA) is an essential process that helps inform the need for health-based regulations. Although there are limitations to this process, it is helpful that all regulatory risk assessments use a common methodology and set of tools. This includes an agreed-upon set of exposure equations, exposure assumptions, and dose-response toxicity information. While there is room to adjust these factors with appropriate justification, starting with vetted data sources and methodologies is key to developing a process that can consistently support sound regulations. The SAB stresses the importance of making these points clear when HHRA is discussed in the draft EJTG. HHRA has several limitations (e.g., limited data, extrapolation from animal studies to humans, extrapolation to low doses, model uncertainties, etc.) and developing EJ analysis in a manner similar to a HHRA may not be the best approach. The SAB concludes, however, that an EJ analysis should involve the evaluation of a common set of criteria that is accompanied by a clear presentation of results. In terms of HHRA, this would be akin to defining all the possible exposure pathways, articulating which ones are complete, and then proceeding to present results for the complete exposure pathways.

The draft EJTG provides a clear and balanced discussion of proximity-based analysis and exposure and risk modeling. It also acknowledges that proximity-based analyses "cannot distinguish between sources based on the level of exposure, risk, or health effects for the population within the boundary" (p. 59). However, there is no discussion of how differences in vulnerabilities, e.g., across race and socioeconomic demographics, may be considered. What are the potential connections between exposure and vulnerabilities that may result in differential health impacts across sub-populations? Can the draft EJTG offer any guidance on appropriate methods for integrating these concerns into either a proximity-based or exposure and risk modeling approach? The SAB also suggests adding a brief discussion in Section 6.4 about characterizing uncertainty and variability in the assessment, particularly when exposure assessments are crude (e.g. proximity assessments).

Furthermore, the SAB stated that Chapter 6 should be broadened to include a careful discussion of the challenges of addressing selection bias and other confounding factors, a major concern for all methods, except for ones that are purely descriptive. The location of households and their exposures to polluting sources are not random, which presents a critical concern for any EJ analysis. A general approach to addressing the problem of non-random assignment are quasi-experimental methods that aim to estimate the effects of interest without confoundedness, reverse causality, or simultaneity. While these methods may not be essential in the context of evaluating the potential EJ implications of regulatory options, some discussion of them could be useful. Specifically:

- **Matching methods:** The SAB suggests that a discussion of the potential for using matching methods to select comparison groups be provided to strengthen this section, including the conditions under which taking these additional steps to construct a control group that is as similar as possible to the treatment group is particularly important (e.g., selection bias is high) and feasible (e.g., sufficient data on treatment and control groups are available).

Matching methods include Propensity Score Matching, which uses statistical techniques to construct an artificial control group by matching each treated unit with a non-treated unit of similar characteristics. The Synthetic Control Method may also be worth mentioning for cases where the impact at a specific location is important. A limitation of matching approaches is the large amount of data that is required on both treated and non-treated populations, which may render this approach of limited use for many of the regulatory cases considered by the EPA.

- **Other methods for causal identification:** In addition to the matching methods outlined above, common examples of quasi-experimental methods include difference-in-differences, regression discontinuity design, and instrumental variables. Many of these techniques have been used in a growing body of EJ economics research to identify the past effects of regulatory actions or other non-market interventions (Cain *et al.,* 2024 and Banzhaf *et al.,* 2019a, Bohren *et al.*, 2022). These methods may be of limited use in this context of assessing potential EJ concerns in regulatory analysis and are significantly more time and data intensive than correlation analysis but may be useful in some cases. Minimally, some discussion of these methods along with key examples from the literature could be helpful in increasing the awareness of analysts to these methods and the types of statistical biases they seek to address.

Section 6.5. Analytical Considerations

Related to the discussion above about using appropriate control groups in an analysis, the first sentence of the second paragraph of Section 6.5.2 reads: "Ideally, the comparison population group for an across-group comparison is as similar as possible to the population group of concern…" This statement is applicable to all comparison groups. The SAB recommends that the text clarify that for all EJ analyses, the analyst should carefully explain why the comparison group provides a useful counterfactual to the population group of concern, how the two groups differ, and whether those differences might be important to the interpretation of results within the EJ analysis and if so, why?

The draft EJTG (p. 63) notes that, "It may be important to evaluate regulatory action effects on both shorter and longer time horizons. For instance, while a regulatory action may result in near-term reductions in emissions, changes in health and other risks may occur on a much longer timeframe. In some cases, effects may even be felt intergenerationally (e.g., climate change). In general, the period of time over which the analysis is conducted should also be consistent with other parts of the regulatory analysis." The SAB recommends that the draft EJTG provide some discussion of methods for considering feedback over time and across space. These are complicated but critically important for EJ analyses that seeks to account for the underlying mechanisms that can lead to an unequal distribution of benefits and harms from regulation. Banzhaf *et al.*, (2019b) outline several general mechanisms, including residential placement/sorting, firm sorting, and the relationship between firm and household sorting.

Similarly, on page 64, the draft EJTG states that, "In selecting a comparison population group, an analyst should…evaluate how different comparison population groups affect the way information is conveyed. When appropriate and practicable, an analyst may wish to conduct a sensitivity analysis using alternate definitions of the comparison population group to provide a more complete depiction of potential effects." The EPA should consider strengthening this in some way, perhaps even elevating the guidance about sensitivity analysis regarding the comparison group to a best practice, given that environmental injustices may exist across many different demographic and socioeconomic sub-populations.

In a later section on the distribution of economic costs, the draft EJTG (p. 77) notes that "While a static analysis may be possible in some cases, it is challenging to anticipate and model the dynamic effects of a regulatory action on migratory patterns and other types of behavioral change…Due to method and data limitations, it might not be possible to predict the total effect of a regulatory action on different population groups. In these instances, the issue can be qualitatively discussed, and the limitations and assumptions associated with characterizing costs explained." As a side note: It seems odd for this discussion of dynamics to come up in the section on the distribution of economic costs, and not in the section on analytical considerations. With these comments, the SAB suggests adding a discussion in Section 6.5 on accounting for dynamics. This caution about the challenges of accounting for dynamic effects may apply best to national-level analyses.

Several other considerations are worth pointing out. First, longer term effects of sorting at a regional scale (e.g., metro area) can be substantial. For example, under some conditions the clean-up of polluted sites can lead to environmental gentrification (Melstrom and Mohammadi, 2022), where amenity improvements result in increased housing prices, leading disadvantaged individuals to move out of newly improved regions. On the other hand, low-income minority residents may be more likely to move into high-risk zones due to differential risks and housing prices (Bakkensen and Ma, 2020). In these cases, understanding disparities in human health impacts from environmental risks requires tracking people's exposure to pollution over time, while incorporating changes in residential locations (Cain *et al.,* 2024).

More generally, with increasing climate change impacts on human health and socioeconomic outcomes, the harms from long-term exposure are likely to be greater than from short-term shocks. Additional data and methods that can allow analysts to account for these longer-term exposures will be important. For example, the availability of long panel data (e.g., data from long-term exposures) has recently made intergenerational studies possible. According to Cain *et al.*, (2024), the application of newly linked long panel data provides novel insights into the intergenerational effects of pollution exposure, opening the door for further research into the intergenerational consequences of environmental injustice.

Given the potential of this type of feedback that can change the spatial and temporal distribution of burdens and harms, the draft EJTG may want to consider if and how to strengthen its guidance for if/when/how to account for impacts over time – and especially for regional-scale analyses. In general, the draft EJTG provides a solid discussion of how to spatially identify and aggregate effects and of methodological issues that may arise, including the challenges of aggregation. The SAB offers these specific suggestions in this regard:

- Analysts are encouraged to "discuss the approach used to create buffers and aggregate geospatial data, as what is most appropriate will vary with the stressor(s) affected and data used in the analysis, and to provide a transparent justification of their choice" (p. 66). The SAB notes that this would apply in a single stressor, not multiple, scenario. The draft EJTG could be strengthened by explicitly addressing the case of multiple stressors by prompting analysts to consider multiple scales as a best practice.

- The draft EJTG discusses the "modifiable areal unit problem" (MAUP) when aggregating spatial data. Given that this is a type of "ecological fallacy" and that this latter term is also sometimes used in the EJ literature, it may be worthwhile to point out that an ecological fallacy can result from MAUP (e.g., MAUP can occur when an average income is assigned to all households living within a census tract. An ecological fallacy occurs when conclusions are drawn based on that assumption).

As mentioned above, there is a growing literature on causality in EJ research (see Cain *et al.,* 2024 and Banzhaf *et al.,* 2019b for recent reviews). This literature is documenting, at least for a handful of cases, some of the mechanisms leading to environmental injustices and the nature of the biases (both in terms of direction and magnitude) that can arise from, for example, using aggregated spatial data, not controlling for confounding effects or simultaneity bias, or not considering dynamic effects, such as sorting, over the long-term. It could be useful to add a compilation of the existing literature in terms of key findings that could be instructional and useful for analysts to add context to their own analyses, e.g., in terms of discussing limitations and the potential nature of the biases that may exist. This is consistent with the guidance that is offered for proximity-based analysis (e.g., to be aware of and discuss the biases and limitations associated with proximity-based analysis, as noted on p. 75 of the draft EJTG, "it may only be possible to draw limited conclusions regarding differences across population groups").

<u>Section 6.6. Characterizing Analytic Results</u>

Section 6.6 provides some nice example tools and metrics for characterizing analytic results in an EJ analysis, but the SAB strongly recommends that instead of a set of examples, the EPA should provide a list of recommended tools and their outputs that would be useful to support a diverse set of regulatory applications. The SAB recommends establishing some minimum standards and developing an analytical approach for EJ that will be more systematic for regulations across the Agency in Section 6.6.1 on the Choice of Summary Metrics. Currently, this section lists several common metrics for analysts to consider and suggests using multiple metrics from this list. As the draft EJTG continues to develop, the EPA should provide additional clarity regarding the descriptive contributions of each of these different metrics, and require, rather than suggest, that analysts choose multiple metrics. For rulemakings in which data are available to support quantitative analysis of EJ impacts, analysts could be required to use all four of the listed metrics, or to explain the data availability constraints that prevent them from doing so if this is not possible. In addition, the SAB notes that the current list of examples does

not include any actual measures of inequality, such as the Gini coefficient. The SAB recommends that the Agency consult the recent literature on environmental inequality and incorporate some of these metrics into the discussion in Section 6.6 (Muller *et al.,* 2018 and Lang *et al.,* 2023).

If comparisons among groups are one of the key deliverables of the EJ analysis, the draft EJTG should require that p-values or confidence intervals for differences between groups be reported. Although arguments can be raised against over-reliance on p-values (see the discussion on p-values provided by the American Statistical Association) in scientific studies, it is important that the uncertainty in the results is transparently described when comparing summary statistics (e.g., averages, proportions, etc.) for multiple groups. Hypothesis testing and confidence intervals provide the means to determine whether there are differences between groups while accounting for the inherent uncertainty in the results. Additionally, in Section 6.6.3, the draft EJTG should include a minimum threshold for determining statistical significance for such tests, as well as, for interpreting regression coefficient estimates, etc. While a threshold p-value of 0.05, the standard in the scientific literature, may be too stringent in data-poor analyses, a threshold value should be accompanied by a stipulation that comparisons that are not statistically significant might still be meaningful (for example, if the number of observations in the population of concern and/or the comparison population is small or the data are highly variable). Therefore, all the estimated statistics in the analysis should be reported, both significant and not significant.

Determining the magnitude of the differences in exposure between groups can be explored using frequentist statistics (e.g., confidence intervals, hypothesis testing); however, the more comprehensive approach, in some cases, is to evaluate whether Bayesian methods[12] could be used. Whether to use frequentist statistics or Bayesian methods may depend on a variety of factors including how the data will be used. The rationale whether to follow a frequentist *versus* a Bayesian inferential framework is mostly related to the structure of the data. Are there complex dependencies? Are there multiple datasets that need to be integrated? In the latter case, it is common that individuals would prefer a Bayesian approach because uncertainty can be more easily described than under a frequentist framework. Another consideration is whether the number of cases is large enough for the Central Limit Theorem[13] to go into effect. In general, Bayesian methods do the same things as more classical methods, but they approach the problem by expressing the estimated values in a different way. For example, the interpretation of a Bayesian credible interval for a variable makes more intuitive sense to a non-statistician than explaining what a "95% confidence interval" represents. Some individuals gravitate toward Bayesian methods when considering hierarchical modeling, which works well

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[12] Bayesian methods add prior probabilities: Has this happened before? Is it likely, based on knowledge of the situation, to happen?

[13] The Central Limit Theorem states that as the sample size increases, regardless of the population's probability distribution, the statistic's sampling distribution looks more and more like a normal (Gaussian) probability distribution. That's one of the many reasons why statisticians tend to advise researchers to, when in doubt, take a larger sample. This theorem is the bedrock for a number of classical statistical procedures.

for such scenarios. When attempting to fit a logistic regression model, the classical approach may be more appropriate. Bayesian methods are more appropriate to apply in situations where it is not straightforward to derive the sampling distributions of the estimators and thus it is not straightforward to depict uncertainty using frequentist methods. The best practice is to let the data and the problem one is trying to answer determine the most appropriate method, model, or procedure. Analysts should not begin with a pre-determined and unyielding mindset to use a certain approach.

Section 6.6.3 explains that regression techniques are approaches that allow control of some factors that might influence the examined relationships. The section provides some examples of the use of regression and its advantages compared to other summary statistical analysis. The SAB recommends including the use of clustered standard errors to improve statistical inference. Clustered standard errors adjust for the correlation of standard errors across clusters, which could be geographic units such as census tracts or counties (Abadie *et al.*, 2023). Clustering standard errors is important in proximity-level analysis or in settings where the treatment assignment (e.g., pollution exposure) is correlated within each group. Therefore, the SAB suggests including clustered standard errors in Section 6.6.3 on Statistical Significance and Other Considerations.

The SAB also suggests that some additional guidance regarding the use of multi-variate regression analysis be provided. The draft EJTG, on pages 74-75, notes that regression techniques can partially control for factors whereas statistical tests on summary data do not. In addition, the draft EJTG states that many of the demographic characteristics that are typically included are highly correlated with each other, making it difficult to interpret the meaning of a coefficient for any given variable. This statement could be strengthened by also pointing out that any addition of a co-variate in the regression equation changes the interpretation of the results. For example, including income or race as a “control” variable in a proximity-based analysis of exposure changes the interpretation of the distance coefficient.

While the draft EJTG acknowledges uncertainty, the references are often exclusively about the uncertainty in the data, uncertainty in the estimates, or uncertainty in predictions. In addition to these types of uncertainty, there exists uncertainty in the statistical methods. In other words, estimates and predictions are all derived conditionally based upon the analyst having adopted a given method for the EJ analysis. The estimates and predictions that the analyst obtains will inherently contain uncertainty. This uncertainty, which can be depicted in different ways (e.g., leveraging asymptotic results in the case of classical or frequentist statistics or using the posterior distribution in the case of Bayesian statistics), is all dependent on the specific statistical model and the statistical assumption made by the analyst. It is plausible that a different set of assumptions and a different statistical approach might lead to different results. This type of uncertainty, called model uncertainty, acknowledges the fact that results can vary depending on the method adopted for the analysis. Recognizing this additional type of uncertainty is important as it may yield more robust results. While it is sometimes challenging to consider and derive results under many different modeling scenarios, there are also techniques, such as Bayesian model averaging or Super learner that allow the analyst to combine results from multiple models into one (Hoeting *et al.,* 1999 and van der Laan *et al.,* 2007).

The SAB recommends that Chapter 6 provide more guidance regarding how to deal with uncertainty. The draft EJTG is relatively sparse on this issue; it states, "Finally, it is important to address and characterize uncertainty. When statistical analysis is used, information such as confidence intervals and variance should be presented. In cases where statistical analysis is not used, uncertainty can be discussed by highlighting limitations in the literature, caveats associated with results, or gaps in the data" (p. 75). However, in Section 6.6.2, where recommendations are provided regarding how to showcase the results of an EJ analysis, there is no mention and no discussion of how to characterize and represent uncertainty. This lack of acknowledgement of uncertainty is also noticeable in Table 6.1 where results are presented without any depiction of uncertainty in the reported proportions. Since throughout the draft EJTG the need to consider uncertainty in EJ analyses is acknowledged, then the examples that are presented should be consistent with the guidance and the uncertainty should be quantified to the extent feasible, and transparently described and included in the results.

In Section 6.6.3, at the top of p. 75, the draft EJTG suggests that analysts control for past discriminatory land use policies such as redlining in a regression analysis exploring disparate exposure to an environmental harm (or benefit). The SAB notes two problems with this suggestion. First, if past discriminatory policies were driven by racial animus, it seems inappropriate to remove the variation in exposure due to such policies when assessing either baseline differential exposure, or policy-induced changes in exposure, even in a purely descriptive analysis. Quantifying current and historic differential exposure, for any reason or set of reasons, should be the focus. Second, while a growing literature establishes statistical associations between current environmental harms and redlining policies (e.g., Estien *et al.,* 2024, Lane *et al.,* 2022), causal relationships are much harder to establish and have not yet been published in the scientific literature. Recommending that EPA analysts demonstrate such relationships in their EJ analysis would set a potentially unattainable statistical standard.

<u>Section 6.7. Assessing the Distribution of Costs and Other Effects</u>

The SAB commends the Agency for highlighting the importance of considering not only the distribution of benefits in an EJ analysis, but also the distribution of costs. It may be worthwhile to mention in Section 6.7 that this is likely to be a particularly important EJ consideration when implementation and compliance costs fall primarily on local communities, such as with new maximum contaminant regulations under the Safe Drinking Water Act. The SAB has a few additional suggestions for this section.

First, Section 6.7.1 discusses the uneven cost burden that may result from some regulations. However, it may also be important to consider any economic co-benefits that may be associated with the regulation for specific groups, for example, a reduction in long-term energy costs from policies that promote renewable energy deployment, or a reduction in local air pollution resulting from policies that would reduce greenhouse gas emissions.

Second, the conclusions from the Fullerton paper cited in this section should be more accurately conveyed. The article cites “higher prices of carbon-intensive products” not simply “higher product prices.” Similarly, the article mentions the “distribution of the benefits from improvements in environmental quality” not “distribution of environmental benefits;” and “temporary effects during the transition” not “transitional effects of the policy.” The SAB recommends also citing Fullerton’s abstract verbatim: *“the consideration of economic costs in an EJ context may be challenging, given a lack of data and methods in many instances.”*

Charge Question #7 - Methodological or Data Gaps

For chapter 7, what do you see as the key methodological or data gaps when analyzing the impacts of regulatory actions on communities with EJ concerns? Which of these gaps do you think should be prioritized in the near- or longer-term to improve how EPA analyzes EJ impacts of regulatory actions?

The SAB has several recommendations to improve key methodological and data gaps. Methodological gaps refer to the processes used by analysts in the EJ analysis. Data gaps include identification of specific data sets that could help analysts identify and inform EJ impacts in the EJ analysis they are conducting for the proposed rule. Many of the concepts and advice presented here appear in the responses to previous charge questions and are reiterated for completeness and emphasis.

Recommendations:

Tier 1

- The SAB recommends consistency in the use of terminology and adherence to definitions provided in the glossary.
- The SAB recommends providing definitions of “extrinsic,” “intrinsic,” “chemical,” and “non-chemical factors,” “effects,” “impacts,” "race," "ethnicity," "people of color," and "vulnerable populations."
- The SAB recommends that the analyst clearly define the scope of the main problem and goals to attain at the outset.
- The SAB recommends using diagrams or visual roadmaps as an aid to document, communicate, and track the rulemaking process.
- The SAB recommends using box diagrams, maps, and graphics to help the public understand the issues, goals, status and implications of the actions, rulemaking, and progress made over time.
- The SAB recommends more synthesis of the current literature to assess the likely conditions that would lead to greater susceptibility associated with populations of concern**.**
- The SAB recommends more guidance on how to address the potential concurrent environmental injustices of climate change exacerbations.

Tier 2

- The SAB recommends combining satellite data and process-based models using machine learning (ML) and/or hybrid ML or some acknowledgment of these emerging methods and implications for EJ analysis.
- The SAB recommends obtaining more data at a finer spatial and temporal resolution.
- The SAB recommends ground-truthing the data (e.g., verifying with direct observation and/or measurement by engaging with affected communities, and meaningfully incorporating the qualitative feedback on lived-experience of environmental conditions).
- The SAB recommends including additional data and methods that allow analysts to account for longer-term exposures including the intergenerational consequences of environmental injustice.

The SAB emphasizes the importance of EPA's EJ analysts acquiring field experience in EJ communities to fill data gaps, understand EJ concerns and improve communication with stakeholders. A significant number of EJ communities never sees nor hears from their federal, state or sometimes even local government, and that has impacted trust. There is no substitute for EJ regulatory analysts putting their boots on the ground in the communities impacted by a proposed rule and listening to their concerns. EPA policy makers and analysts are also encouraged to leverage and collaborate with the knowledgeable state, tribal and EPA Regional office staff to better understand local community experiences across the country. If there is first-hand knowledge and experience listening to, collaborating with, and living in the EJ communities impacted by proposed rule then the concept of authentic meaningful engagement should come naturally; you will be listening to and engaging with your neighbor and fellow community member.

<u>Methodological Gaps</u>

Described in more detail in the following paragraphs, the EJSARP has the following recommendations to fill methodological gaps:

- Clarify definitions and terminology usage.
- Define the scope of the main problem in the analysis.
- Select the baseline and identify its importance to the analysis.
- Improve communication of data gaps, results, and expectations because of proposed rule.
    - Incorporate visual aids when communicating results.
- Increase predictive model efforts and account for dynamics.
- Augment synthesis efforts of the current literature to assess the likely conditions that would lead to greater susceptibility associated with populations of concern.
- Provide more guidance on how to address the concurrence of environmental injustices exacerbated by climate change.

The SAB recommends consistent use of terminology and adherence to definitions provided in the glossary. Terms should be consistently defined in the glossary, not in footnotes. The SAB recommends clarifying the terms, “extrinsic,” “intrinsic,” “chemical,” and “non-chemical.” There was a suggestion that an appendix of what EPA considers extrinsic or intrinsic factors be included in the EJTG. Alternatively, a website with clear definitions and examples of what could be considered extrinsic, intrinsic, and chemical and non-chemical factors could be helpful. The SAB also suggests the inclusion of social stressors such as job loss, lack of health insurance, disinvestment of infrastructure as extrinsic factors.

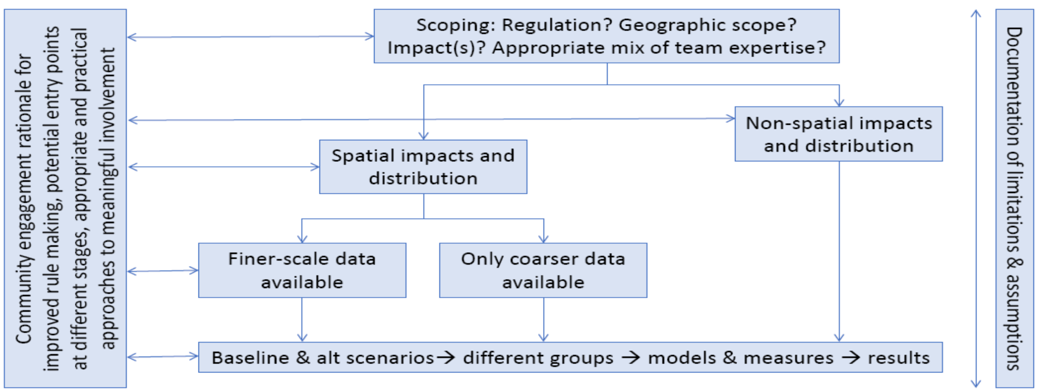
Another term that needs clarification is "effects"; it is defined in the glossary. The draft EJTG indicates that it is sometimes used interchangeably with "impacts"; however, it may mean different things to different analysts. The consistent use and well-crafted definitions of "race," "ethnicity," "people of color," and "vulnerable populations" are recommended. The terms "race" and "ethnicity" are often sensitive topics for minority and disadvantaged communities and are missing from the glossary in the 2023 version of the EJTG. While these terms are social constructs and not all federal agencies may have the same definitions, which might complicate the data usage, it is important to have thoughtful definitions in EPA's EJ analysis guidance consistent with other EPA guidance documents.

A key recommendation is to enhance human health risk assessment by clearly defining the scope of the main problem and goals to attain, which can guide all EJ analyses and help inform decisions at a strategic level. Within a human health risk assessment, there is still the need for data using mixed-method strategies to elucidate the links between demographics and response to environmental and social stressors, both of which have resulted and will likely continue to result in adverse effects. Data from toxicological, epidemiological, exposure, and other STEM sciences along with sociology, environmental anthropology, and other social sciences are some examples of transdisciplinary data that could better inform decision makers. The SAB recommends that data gaps in exposure assessment be filled, explicitly to inform toxicological effects and toxicokinetic and toxicodynamic understanding across different life stages, especially for infants and children into adulthood.

The SAB emphasizes the importance of baseline selection, and acknowledges the challenges for determining a baseline, especially when, for many EJ communities, the “baseline” might be far in the past or data do not exist on the position of the baseline, especially in the rural-urban continuum. This topic, although addressed in Chapter 5, is recalled here because guidance on baseline selection is an important methodological consideration for all EJ analyses.

Additional data on risk communication and outreach are also recommended for meaningful engagement with impacted residents. These data are needed to communicate the effects of environmental and social stressors on EJ communities, and to track engagement data at various stages of the rulemaking process in different regions of the country. The SAB recommends using diagrams or visual roadmaps (e.g., see Figure 4 below) as an aid to document, communicate, and track the rulemaking process, including the identification of the problem, scoping of the issues, planning, execution of actions/plans, and at what steps to communicate with stakeholder communities actively and meaningfully. The parameters denoted in the final step (e.g., baseline, alternate scenarios, groups, models, etc.) will differ based on the type, quality and quantity of data that are available.

Figure 4. 'Roadmap' of EJ Analysis & entry points for community engagement & decision making.



Visualizations can aid in communication of data gaps, and the impact of a proposed rule. Visualizations that are succinct and efficient, such as box diagrams, maps, and graphics, could help the public understand the issues, goals, status and implications of the regulatory actions, and progress made over time to build and retain trust. Concurrently, the analysis and supplementary work should include the important technical details such as assumptions, limitations, measurement uncertainties and combined uncertainties, etc. This information should be available publicly in an *open* transparent fashion for academicians or other members of the public to review.

The SAB also notes that managing and communicating expectations with stakeholders, such as the timeline required for EJ communities to observe tangible benefits, is an important consideration. Effective, open, and timely communication is essential, as it is reasonable to expect that filling data gaps, analyzing, interpreting and ground-truthing the data, and translating the scientific understanding into regulatory processes will require a prolonged period of time before these communities observe improvements. The EPA should make every effort to build and retain trust with EJ communities and stakeholders as well as track data on community engagement.

The SAB proposes that the findings from predictive models be considered in EJ analyses to account for dynamics with awareness of the inherent uncertainty. The draft EJTG identifies the need for conducting risk evaluations and EJ analyses that can account for how population demographics are expected to change over time (including both geographical shifts of the U.S. population and population demographics and/or exposure dynamics over time due to aging and migration). Several approaches have been presented in the literature to project potential climate-induced migration. For example, Fan *et al.,* (2018) link a residential sorting model to an interregional computable general equilibrium model of the United States to capture wage and housing price feedbacks to assess the economic impacts of climate-change-induced regional migration. More recently, quantitative spatial models in urban economics are being developed that account for spatial patterns of migration at regional scales, e.g., 1° x 1°. Cruz and Rossi-Hansberg, (2021) link temperature changes to local productivity and amenities via climate damage functions and use their calibrated model to simulate the global economy to year 2200 to compare welfare losses over space due to climate change impacts on productivity and amenability of different global locations. Other examples include Bakkensen and Ma, (2020) and Sheldon and Zhan, (2022). Such models are unlikely to be implementable under the time constraints of a regulatory analysis, but a synthesis of findings from this growing literature may be useful for helping analysts to better understand the relative magnitude of migration effects (e.g., relative to other adaptations) and implications for spatial inequities across sub-national regions.

The SAB recommends more synthesis of the current literature to assess the likely conditions that would lead to greater susceptibility associated with populations of concern. While this may require additional time and effort, it is nonetheless an important step in understanding the impact of potential exposures and under what conditions. The draft EJTG points to the need for dose-response modeling that accounts for differences in susceptibility associated with population groups of concern and states that "an important first step would be to produce a comprehensive review of each relevant dose-response function that includes an analysis of baseline risk variation across different population groups. This information would enable analysts to consider the range of population-specific risk distributions along the dose-response." In a similar spirit, a comprehensive review of the literature in other domains could be helpful. For example, a synthesis of studies that have considered household or firm sorting in response to spatial patterns of pollution or climate change impacts could be helpful for improving analysts' qualitative understanding of these longer-term effects and the conditions under which dynamic effects may lead to unintended exposures that disproportionately affect population subgroups.

Finally, the SAB recommends more guidance on how to address the concurrent environmental injustices exacerbated by climate change. In the draft EJTG, there is currently a side box (text box 4.1) addressing climate change and EJ communities. Many of the disproportionate effects of climate change and climate-induced environmental hazards are well known and recent research is documenting the observable effects of these changes. For example, heat-related disparities have been linked to redlining and climate-related floods and wildfires have been shown to disproportionately affect the same or similar low-income and minority communities. Longer term projections of the potential effects of a pollution change under a regulatory option are critical for capturing potential impacts on future EJ outcomes. Climate change also has an impact on the population dynamics mentioned earlier; for example, migration from warmer southern climate to northern states; or climate change impacts on tourism and local economies in EJ communities.

<u>Data Gaps</u>

Described in more detail in the following paragraphs, the SAB has the following recommendations regarding data gaps in the EJ analysis:

- Enrich existing datasets by leveraging and incorporating existing data from outside EPA into the EJ analysis.
- Incorporate methods to address sparse data problems.
- Obtain data at finer spatial scale and temporal resolution.
- Ensure the analyst has a clear understanding of the nature and limitations of data types.
- Close the data gaps to develop a comprehensive approach to understand the relationship between exposures and health outcomes across various time frames and life stages.
    - Close the gaps in exposure data and toxicokinetic and toxicodynamic understanding between life stages, especially infants, children and into adulthood.
    - Incorporate short and long-term datasets to evaluate change.
    - Include longitudinal data on exposures and health outcomes.
    - Adequately delineate methodologies used in identifying "hot spots" in analyzing the impacts of regulatory actions on communities with EJ concerns and incorporate qualitative and quantitative data holistically in analyses both near/long term.
    - Incorporate data on proximity of affected communities to polluting facilities and population demographics in all analyses of the impact of regulatory actions on communities with EJ concerns, in order to adequately address EJ concerns of overburdened communities.

The draft EJTG acknowledges the importance of leveraging datasets outside the EPA. Various federal partners, like the Interstate Technology Regulatory Council, Environmental Research Institute of States, and Environmental Council of States, along with state entities such as State Laboratories and Departments of Environmental Quality, have amassed extensive datasets on targeted pollutants over several decades. These resources could significantly contribute to filling environmental justice data gaps. Furthermore, agencies like the Centers for Disease Control, Food and Drug Administration, the United States Geological Survey, and U.S. Census Bureau possess datasets pertinent to analyzing the effects on stakeholder communities, alongside the EPA. Another well-known data gap includes the conditions in Tribal and Sovereign Nations that lack stable relationships with the Federal Government to deal with social and environmental stressors. Incorporation of short and long-term datasets to assess change will be critical to evaluate effectiveness of a rule.

The SAB welcomes the inclusion of tribal communities and disability status, following Presidential E.O. 14096. The SAB noted, however, that the focus of the draft EJTG remains on using population data derived from the US Census or American Community Survey (ACS), which represent residential and nighttime distribution of people. The draft EJTG does not emphasize the need to incorporate daytime exposure or risks in EJ analyses, specifically those encountered in schools and workplaces if the proposed regulatory actions apply. There are national datasets of daytime population exposures/activities that have now been developed and could be used, along with Census data on racial/ethnic and socioeconomic status of workers. Recent EJ studies (e.g., Elliott *et al.*, 2019; Yoo *et al.,* 2023) for example, have compared racial/ethnic disparities in pollution exposure at residential *versus* workplace locations using census tract-level data. Potential data sources include the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) data products (e.g., Origin-Destination Employment Statistics, as well as commuting flows and worker characteristics published by Census Transportation Planning Products (CTPP)). It is also important that EJ assessments in rulemaking consider other sensitive or vulnerable groups more explicitly, under the definition of population groups of concern. Schools, daycare centers, prisons, hospitals, health care facilities, and other sites that are inhabited by vulnerable people should be incorporated in EJ analyses, especially because many of these datasets are now available publicly. For example, annual data on school locations and their enrollment characteristics in the U.S. are published by the National Center for Education Statistics[14] and data on prison facilities are published by the Federal Bureau of Prisons[15]. Furthermore, within the discussions of communities that have been historically marginalized, overburdened, and undeserved, the SAB contends that the draft EJTG should also include quasi resource colonies in rural America, e.g., Appalachia, the coal fields of the Powder River Basin, and states like North Dakota and South Dakota, where resource extraction has impacted local farmers and Indigenous communities alike. Some of these communities or resource colonies are also characterized by a distrust of EPA and other government agencies.

The draft EJTG points out that estimates from areas with low population are likely to have larger margins of error and reduced accuracy. Current practice is to aggregate data to larger spatial units or consolidate data into larger population subgroups. An alternative approach would be to combine satellite data and process-based models using machine learning (ML) and/or hybrid ML and process-based modeling methods. Clearly the latter is much more time intensive, but this research area is growing rapidly and there are increasing numbers of data products that are being generated. What are the trade-offs of these various approaches and types of data? For example, what are the advantages and disadvantages of using actual data that are more spatially aggregated to establish the baseline *versus* simulated finer-scaled data that rely on assumptions about the underlying processes? Under what conditions might one approach or type of data be preferred? In addition, how can these emerging hybrid-ML methods be used to generate more fine-scaled predictions of the impact of regulatory options? Because these hybrid models incorporate process-based models whose structure (parameters, etc.) can be altered to reflect the hypothesized change in a regulation, they have strong potential for projecting a plausible range of outcomes under various regulatory options at a fine scale. This also eases the burden and expense of data collection.

Recent advances in satellite data technology combined with ML methods have enabled finer-scale predictions of pollution and exposure measures. Di *et al.,* (2016) use ML to combine data from satellite imagery, pollution monitors, land use characteristics and chemical air transport models to generate fine-grained (one kilometer grid) measures of ambient air pollution levels

[14] See https://nces.ed.gov/ccd/elsi/tablegenerator.aspx
[15] See https://www.bop.gov/locations/list.jsp#

for the entire United States. These data products have been used to assess disparities in environmental justices. Currie *et al.,* (2023) combined these granular pollution data with individual survey responses from restricted versions of the 2000 census and the 2001–2015 American Community Survey at the census block level to explore cross-sectional differences in environmental inequality between racial groups and causally identify the determinants of the narrowing pollution gaps between racial groups over time. Importantly, the spatially continuous air pollution measurements enable the analysis of the entire continental United States as opposed to focusing on a single community or metropolitan area. These methods can also be used to -describe the uncertainty of a prediction. For example, Di *et al.,* (2019) use an ensemble model that integrates three ML algorithms and estimates of $PM_{2.5}$ in which monthly uncertainty levels of the prediction(s) are also estimated.

Related methods to address data scarcity problems are so-called hybrid models that combine aspects of process-based and ML models. For example, Knowledge-Guided ML (KGML) methods leverage the information contained in data without ignoring the scientific knowledge embedded in process-based models (e.g., Liu *et al.,* 2022). Scientific theories (e.g., the principle of mass and energy conservation) are used to guide construction and training of ML models. By using scientific knowledge to constrain the ML model, this provides a means to counter the out-of-sample failure and massive data demands of traditional ML approaches. For example, Feng *et al.,* (2022) use KGML to project trained (streamflow) and untrained variables (for example, soil and groundwater storage, snowpack, evapotranspiration, and baseflow) for 671 basins across the USA. A full discussion of these emerging models and methods and the kinds of trade-offs that they imply for analysts may be beyond the scope of this current update, however, at a minimum, some acknowledgment of these emerging methods and implications for EJ analysis at EPA should be included and would strengthen the EJTG.

The SAB agrees that, to fill data gaps, EPA's priority is to obtain more data at a finer spatial and temporal resolution. Finer resolution data on a temporal and spatial dimension for demographic data, targeted pollutants in air, water, groundwater sources, and geogenic sources that impact our surroundings can be critical for an EJ Analysis. While ML and statistical methods have been improving over time, assessing the accuracy of these data processing methods to predict, impute or interpolate values correctly requires comparing estimates and predictions with observed properties. Without the operation of ground-truthing the data, it is impossible to have an accurate assessment of the appropriateness of methods used to perform an EJ analysis. The pollution data should include different types of pollution. For example, while air pollution data are relatively available, data on other types of pollution are not. Spatially explicit and more comprehensive data on water pollution, for example, are needed to link water pollution upstream with impacts downstream.

The importance of accounting for underlying heterogeneities, multiple stressors, cumulative effects, and hotspots underscores the need for more spatially disaggregated data, e.g., at the block or block group levels. Increasingly remotely sensed data, including from satellite, sensors, and other sources, are providing finer-scale data on pollution and other environmental and social conditions that can be sensed remotely. However, additional efforts for more purposeful and comprehensive data collection are needed to augment these data, including:

- More comprehensive demographic, health, and social data nationwide that can be used to better assess existing (baseline) vulnerabilities of localized areas to overcome the spatial aggregation problems discussed in Chapter 6 in the EJTG.
- Targeted data collection in areas that are known to have a paucity of data that can lead to biased results. Pollution monitors, for example, may have systematically less coverage across minority or poor communities.
- Augmented data collection in rural areas with low population, to avoid having to combine data across geographic units or consolidate data into population subgroups.
- Randomized data collection to facilitate more causal inference that can better describe and present effects of past policy changes and help to parameterize a plausible range of outcomes under alternative scenarios of regulatory implementation.
- Acknowledgement of limitations of ACS data for the demographic data gaps.

As stated in SAB's Review of the Science Supporting the Proposed Rule Titled, *New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule (RIN 2060–AV09)* report: "For socio-demographic variables examined in the proximity and exposure analyses (Section 6 of the RIA), data are obtained from the United States Census Bureau's American Community Survey (ACS) five-year estimates. These ACS estimates are surrounded by uncertainty, which are quantified through the margin of error (MOE). The magnitude of the MOE is typically considerable for estimates obtained at the census block group level, and particularly higher in rural areas with lower population counts. To mitigate against measurement errors and derive reliable proportional estimates, researchers have suggested removal of census enumeration units (i.e., tracts or block groups) with small population counts from their analysis, and/or using census units where MOE of the estimates are relatively low. Although the EJ analysis presented here uses census block groups and tracts, data quality problems with the ACS socio-demographic data (e.g., missing values and higher MOE) are not acknowledged and it is unclear if appropriate techniques were used to address data uncertainty and related errors."

For health data gaps, the draft EJTG should advise analysts to consider which groups may be under-represented in national scale health datasets that are commonly used (e.g., from tribal health systems, migrants, etc.). The differences in study designs and approaches pose a challenge to meta-analysis of pollution exposures and health outcomes (Cain *et al.,* 2024). The Agency could coordinate more studies that use the same design to facilitate meta-analyses that can summarize results across a range of locations and conditions. Additionally, it is important that in the effort to acquire more data to fill data gaps, that EPA is completely clear and aware of the nature of the data: are these datasets measured observations obtained from an instrument, or are the data themselves the result of a black box algorithm or statistical methods, and what is the total uncertainty level associated with each data set.

Due to the complexity of data collection, analysis, and interpretation of multiple variables, the SAB recommends the utilization of the EPA tiering approach to assess impacts on EJ communities and assist in addressing the targeted pollution problems. There is value in exploring reverse engineering approaches to identify clusters at lower resolution levels in adversely impacted communities and model the environmental and social stressors contributing to the conditions. The scientific community is currently limited to assessing targeted or known pollutants and not unknown variables. Unknown pollutants, emerging contaminants, or unintended social stressors such as loss of health insurance when an industry closes due to regulatory constraints might be drivers of observed impacts.

Finally, longitudinal data on exposures and health outcomes are increasingly important. With more frequent climate change impacts on human health and socioeconomic outcomes, the harms from long-term exposure will likely increase – whether additively, or synergistically – and an increase in inequities is expected. Additional data and methods that can allow analysts to account for these longer-term exposures will be important. For example, the availability of long-term panel data has recently made intergenerational studies possible. According to Cain *et al.*, (2024), the application of newly linked long panel data provides novel insights into the intergenerational effects of pollution exposure, opening the door for further research into the intergenerational consequences of environmental injustice. The SAB recommends a comprehensive approach to understanding the relationship between exposures and health outcomes across various time frames and life stages. More exposure data are needed to elucidate the toxicokinetic and toxicodynamic differences between life stages, especially infants, children and into adulthood. Furthermore, data acquired for residential locations only provide a partial accounting of potential exposures. Data on travel and workplace locations, including commuting patterns for work and school are also needed.

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APPENDIX A - Minor Comments

Chapter 4

- Footnote 40 on page 23 also states if “a state partner is not taking timely or appropriate action to address threats…EPA has the authority and responsibility to take direct action.” The SAB questions (1) if inclusion of instances such as, Class II well primacy under the Underground Injection Control program, and (2) if “state partner” includes entities such as county commissions?
- Text Box 4.1 on page 25, Increased Vulnerability to the Impacts of Climate Change, the SAB recommends: (1) stating, increased vulnerability to impacts of climate change – such as sea level rise, drought, wildfires, and (2) adding the word “intensity” to the description of extreme events.

Chapter 5

- Figure 5.1: Note that the "extrinsic factors" imply enhanced risk, but the “intrinsic factors” do not. Thus, consider replacing the "intrinsic factors" of "age" with "older age", and "genetics" with "genetic predisposition" (or something like those phrases). Those changes recommended to "intrinsic factors" would then align with the phrasing for “extrinsic factors.”
- On page 28: Note that the “Jbaily *et al.*, 2022” article cited is *not* a human health risk assessment. It simply examines PM2.5 exposure disparities by race/ethnicity and income. It shouldn’t be cited after that sentence. The following citation would be much more appropriate here: Josey, K. P., Delaney, S. W., Wu, X., Nethery, R. C., DeSouza, P., Braun, D., & Dominici, F., (2023). Air pollution and mortality at the intersection of race and social class. *New England Journal of Medicine, 388*(15), 1396-1404.
- Page 29 states: “The limited utility of national data for informing health disparities and the limitations of extrapolating community-level data from national surveys has also been noted.” That statement is vague and clarification would improve it.
- Text Box 5.3: Examples of EJ-Related Questions to Consider During Problem Formulation, the *subsection on Differential Exposures to a Stressor asks,” •Are there products/consumer goods that contain the stressor? •Are these products/consumer goods used at noticeably higher rates among population groups of concern? •Are there cultural practices or other activities that are unique to these population groups? •What is the frequency and duration of occurrence of the unique cultural practice or atypical activity?*” This material diverges to some extent from the text on p. 41 about other behaviors that might influence differential exposures between population groups (e.g., “hand-to-mouth behavior of small children; use of personal care or cleaning products that contain harmful chemicals; fish consumption for subsistence or cultural reasons”).

Chapter 6

Section 6.5

- In Section 6.5.2, paragraphs 2 and 3 seem to confound emissions and concentrations in both the across-group and within-group discussions. The text states (in both cases): "If the analyst has information on *emissions,* he or she can compare the average *concentrations*…" Making this connection would not be possible without modeling the link between emissions and concentrations. The SAB recommends editing this statement.

- On page 68, it is important to note here that analysts not trained in qualitative methods should not lead qualitative research – this should be done by someone with proper training.

- On page 73, consider strengthening support for visualization of spatial patterns as an important data exploration/descriptive activity, e.g., that maps can help with visualizing and elucidating spatial patterns that otherwise are not discernable in tabular format. This section could also include some cautionary guidance about the appropriate classification scheme (e.g., equal interval classification could obscure non-normal distribution of the spatially autocorrelated data). Before finalizing the draft EJTG, it would be useful to consult a geographer to adequately express this in the narrative.

Section 6.4

- In Section 6.4.1, the SAB suggests adding a sentence at the end of the last paragraph preceding the bulleted list of advantages and disadvantages of proximity-based analysis, stating as follows: "The coefficient estimates from such a regression would not be interpretable as causal effects of race, income or other EJ characteristics on stressor source location, but may provide helpful descriptive information on differential exposure."

Chapter 7

- The link on page 81, in footnote 92 referring to EPA's online *EJ Glossary* should be corrected as it appears to be out of date.

APPENDIX B – Example of Structural Racism

The air quality monitoring system in the U.S exemplifies structural racism in three ways. First, the regional scale of subnational monitoring for compliance with the federal Clean Air Act (CAA) can obscure localized air pollution hot spots. In a 2018 publication, one environmental law professor described the CAA's blindness to microclimates harboring hot spots. "The most prevalent of these pollution hotspots occur in predictable patterns around heavily trafficked roads and industrial facilities. Low-income communities and communities of color are much more likely to live in polluted microclimates and suffer health effects as a result" observed UCLA's Ann Carlson (2018, p. 1036).

The structural roots of these blind spots can be traced to the nation's first air quality act in 1967. That law ordered states to create Air Quality Control Regions (AQCRs), adopt standards for air pollutants, and develop implementation plans to meet those standards according to Gaulding (1968). AQCRs were to be established based on meteorological, topographical, social, and political factors shared by a group of communities. Such regions became the spatial unit for monitoring and complying with air quality standards.

Another legal scholar described how an air toxics loophole remained after amendments to the CAA in 1990. "AQCRs swallow hot spots because CAA compliance is based on meeting standards at the *regional* rather than the *local* level and does not distinguish between regional and local air quality data for compliance purposes" according to Magdalena Gonzalez (2021, p. 145). Arguably, the regional scale of monitoring and compliance represents the Modifiable Areal Unit Problem (MAUP) discussed in chapter 6. A regional air quality monitoring and compliance structure masks localized pollution hotspots possibly impacting minority and poor neighborhoods.

A 2020 audit by Government Accountability Office (GAO) analysts corroborated this legal scholarship. Federal auditors reported the air monitoring system "barely meets current data management needs because the architecture of the system—which dates back to the 1990s—is antiquated and inflexible." GAO analysts also documented how air quality monitoring grants from the EPA to states declined by 20 percent since 2004. Another 2020 Reuters investigation reported how antiquated air monitors missed localized pollution disparities and the impacts of industrial explosions (Sanicola, Kearney, and Sanicola, 2020). Likewise, Propublica journalists mapped more than a thousand U.S. hot spots of cancer-causing industrial air toxics pollution (Younes *et al.,* 2021).

Those missed air toxics hot spots reveal a second structural racism feature of U.S. air quality laws and monitoring. Currently, EPA's National Air Toxic Trends Station (NATTS) network includes just 26 air monitors. In 2004, National Research Council (NRC) experts found U.S. air quality systems inadequate to characterize toxic hot spots. NRC's Committee on Air Quality Management in the United States concluded the following.

“Current monitoring data and understanding are not sufficient to adequately assess the relative risks to human health and welfare posed by exposure to the myriad pollutants in the environment, as well as to the myriad microenvironments or hot spots in which these exposures may occur. Development of such a capability will be a major challenge and will require a substantial investment in resources for monitoring and effects research over a long period of time” (NRC, 2004, p. 87).

A series of scientific studies began supporting NRC’s judgement. Not all particle pollutants measured by PM2.5 or PM10 monitors are equally hazardous. Also, a patchy air monitoring network inadequately captures air toxics variations in many urban riskscapes. Finally, any community scaled epidemiological time-series based on current air monitors suffer from an ecological fallacy. In this case, public health research can only rely on a few air toxics monitors and coarse models to estimate local or household level longitudinal impacts.

For example, a seminal study of the St. Louis region based on 10 air monitors found highly heterogeneous spatial distributions of source contributions and the elemental components in PM2.5 measurements. They concluded that “there is the potential for exposure misclassification when a limited number of ambient PM monitors are used to represent population-average ambient exposures” (Kim *et al.,* 2005, p. 4172).

In Pinto *et al.*’s (2004) nationwide study of EPA collected PM2.5 data variability at 1, 000 monitoring sites in 27 Metropolitan Statistical Areas, their analysis found a large range of intraurban correlation coefficients especially in Western cities. They concluded that a potential risk of exposure misclassification errors existed for time-series epidemiologic studies. Likewise, a subsequent meta-analysis of 33 intraurban particulate studies found nine with homogenous PM distributions while 17 found heterogeneous distributions (Wilson *et al.,* 2005). These researchers advised caution in the use of one or a few central monitoring sites as proxies for epidemiological studies of population exposures.

One of those 33 studies reviewed in Wilson *et al.,* (2005) originated in Seattle, Washington. Appearing in 2004, a University of Washington team monitored PM2.5 at 40 outdoor sites. Goswami *et al.,* (2002) found significant spatial variability in particle pollution measurements. However, their objective was not to better estimate intraurban PM2.5 variability. Instead, they aimed to identify the one site most representative of ambient PM 2.5 exposures among Seattle’s most susceptible populations.

They reported that Washington’s environmental agency, the Department of Ecology, sought to optimize scarce resources that could only support one new location representative of the average population exposure in Seattle (Goswami *et al.,* 2002). A residential neighborhood site was selected. But after several years, funding ran out and that site was closed. Moreover, hot spots are not average. As observed in one publication, “not all pollution exposure risk is average” (Abel 2008, p. 232). Particle pollution hot spots often involve clusters of elevated concentrations or outliers in the upper tail of a distribution. Such “skewed riskscapes” are obscured by statistical averaging techniques.

In a subsequent series of publications on Seattle's skewed or segregated riskscape, toxic air polluters reconcentrated in the Duwamish River Valley airshed (Abel and White, 2011; Abel, White, and Clauson, 2015; Abel, White, and Clauson, 2019). Yet, the city's only NATTS monitor over 300 feet above the valley. Surrounded by a park and golf course, the nearest air polluter is 2.88 kilometers to the southwest.

Expectedly, another Seattle study with six Hazardous Air Pollutants (HAPs) monitors found significant spatial variations in most air toxics. Wu *et al.,* (2011) recommended that many more HAP monitors were needed in Seattle operating over multiple years to properly estimate population exposures.

A potentially more pernicious problem with the US Air Quality Monitoring System (AQMS) may have been revealed in a 2021 study. University of Oregon economics professor Eric Zou (2021) used NASA satellite measurements of air quality for "on" and "off" monitoring days. Regulatory air monitors collect pollution data intermittently rather than continuously. EPA allowed clean air authorities to episodically monitor air quality long ago because daily collections are costly (Akland, 1972; Gilbert, 1997). However, every fall, EPA publishes the air monitoring rotation for the upcoming year.

Zou likened the practice and its results to what we expect when phone apps post speed trap locations. Polluters may engage in strategic behavior just like drivers. They obey the speed limit where enforcement is expected; speed when police are reportedly missing. Zou's analysis of pollution captured by satellite imagery was 1.6 percent less on days scheduled for monitoring *versus* nonmonitored days. When air pollution levels approached allowable amounts, the emissions gap was seven percent on monitored *versus* unmonitored days. Moreover, pollution levels remained unchanged during good air quality periods. So, Zou hypothesized that polluters engaged in "strategic behavior" and slowed pollution when monitored.

Surprisingly, Zou's results also suggested local governments might also influence strategic pollution slowdowns. He found the likelihood that local governments issued air quality advisories was 10 percent higher on monitored days. State and local governments face regulatory penalties for noncompliance. Thus, Zou postulated that local clean air authorities may play a role in coordinating emissions reductions.

Another 2021 study of 14 metropolitan areas produced similar results. Mu, Rubin, and Zou (2021) found a 33 percent reduction in monitoring occurred on high pollution days for clusters of monitors managed by local governments. Similarly, a study of air pollution detected by satellite imagery concluded that approximately 24.4 million more Americans than previously estimate may be breathing unhealthy air (Sullivan and Krupnick, 2018). Both groups of analysts concluded that monitor placement likely was strategic to make state and local compliance with clean air laws easier.

In addition to the "difficulty and cost of siting and maintaining monitoring equipment", we have the issues that reveal themselves when monitoring large industrial corridors with multiple operators like we see along Houston Ship Channel, Southwest Detroit, and Corpus Christi, Texas, to name a few. Assigning emissions levels to emissions sources across such large parcels with so many companies is extremely daunting.

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